IMP. INST. ENTOM.
— LIBRARY —
No. 6806

TRANSACTIONS

OF THE

ROYAL ENTOMOLOGICAL SOCIETY

OF

LONDON

Digitized by the Internet Archive
in 2025

https://archive.org/details/ecological-entomology_1935_83

THE TRANSACTIONS OF THE ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

VOL. LXXXIII

LONDON
PUBLISHED BY THE SOCIETY AND SOLD AT ITS ROOMS
41 QUEEN'S GATE, S.W. 7

1935

DATES OF PUBLICATION OF PARTS

Part I (pp. 1–176)	Published 27th June, 1935
Part II (pp. 177–312)	Published 28th November, 1935
Part III (pp. 313–448)	Published 20th December, 1935
Part IV (pp. 449–574)	Published 30th December, 1935

THE ROYAL
ENTOMOLOGICAL SOCIETY OF LONDON.

Founded 1833.

Incorporated by Royal Charter 1885.

PATRON: HIS MAJESTY THE KING.

OFFICERS and COUNCIL for the SESSION 1935-1936.

President
S. A. NEAVE, O.B.E., M.A., D.Sc., F.Z.S.

Vice-Presidents.
C. L. COLLENETTE.
H. ELTRINGHAM, M.A., D.Sc., F.R.S.
A. D. IMMS, Sc.D., M.A., F.R.S.

Treasurer.
FRANCIS HEMMING, C.B.E., F.L.S.

Secretary.
A. W. McKENNY-HUGHES, D.I.C.

Registrar.
F. J. GRIFFIN, A.L.A.

Other Members of Council.
Prof. W. A. F. BALFOUR-BROWNE, F.R.S.E., F.L.S.
Prof. P. A. BUXTON, M.A.
Prof. G. D. HALE CARPENTER, M.B.E., D.M.
Brigadier W. H. EVANS, C.S.I., C.I.E., D.S.O.
G. FOX-WILSON.
K. JORDAN, Ph.D., F.R.S.
R. S. MACDOUGALL, M.A., LL.D., D.Sc., F.R.S.E.
N. D. RILEY, F.Z.S.
J. A. SIMES, O.B.E.
W. H. THORPE, M.A., Ph.D.
C. B. WILLIAMS, M.A., Sc.D.

Trustees of the Society.

R. W. LLOYD.
Prof. E. B. POULTON, F.R.S.
The Rt. Hon. LORD ROTHSCHILD, F.R.S.

Finance and House Committee.

Brigadier W. H. EVANS, C.S.I., C.I.E., D.S.O. (*Chairman*).
R. ADKIN.
E. A. COCKAYNE, M.A., M.D., F.R.C.P.
C. L. COLLENETTE.
H. WILLOUGHBY ELLIS, F.Z.S.
R. W. LLOYD.
O. W. RICHARDS, M.A., D.Sc.

Publication Committee.

A. D. IMMS, Sc.D., M.A., F.R.S. (*Chairman*).
Prof. G. D. HALE CARPENTER, M.B.E., D.M.
H. ELTRINGHAM, M.A., D.Sc., F.R.S.
Sir GUY A. K. MARSHALL, C.M.G., D.Sc., F.R.S.
M. E. MOSELY.
W. H. T. TAMS.
W. H. THORPE, M.A., Ph.D.

Library Committee.

K. JORDAN, Ph.D., F.R.S. (*Chairman*).
K. G. BLAIR, D.Sc.
Prof. P. A. BUXTON, M.A.
L. G. HIGGINS, M.A., F.R.C.S.
R. W. LLOYD.
H. SCOTT, M.A., Sc.D.
H. J. TURNER.

Committee for the Protection of British Insects.

The Rt. Hon. LORD ROTHSCHILD, D.Sc., F.R.S. (*Chairman*).
R. ADKIN.
Capt. E. BAGWELL-PUREFOY, F.Z.S.
W. J. DOW.
J. C. F. FRYER, O.B.E., M.A.
Col. F. A. LABOUCHERE.
N. D. RILEY, F.Z.S.
W. G. SHELDON, F.Z.S.
H. M. EDELSTEN (*Secretary*).

The Executive Officers of the Society are *ex-officio* members of all Committees.

CONTENTS

PAGE

Arrow (Gilbert J.). A contribution to the classification of the Coleopterous family Lucanidae 105

Benson (Robert B., M.A.). The high mountain Sawflies of Britain (Hymenoptera Symphyta) 23

Carpenter (Prof. G. D. Hale, M.B.E., D.M., F.L.S., F.Z.S.). The Rhopalocera of Abyssinia: A Faunistic Study. With Notes on particular points by W. H. Evans, C.S.I., C.I.E., D.S.O., Francis Hemming, C.B.E., G. Talbot, and E. J. Wayland 313

Cockayne (E. A., D.M., F.R.C.P.). The early stages of *Minoa murinata* Scop. (Lep., Geometridae) with a description of the verrucae of the larva 41

Cockayne (E. A., D.M., F.R.C.P.). The origin of gynandromorphs in the Lepidoptera from binucleate ova 509

Eltringham (H., M.A., D.Sc., F.R.S.). On the brush-organs of the male *Lithosia griseola* Hübn. (Lepidoptera) 7

Gillett (J. D.). The genital sterna of the immature stages of *Rhodnius prolixus* (Hemiptera) 1

Marshall (Joseph). The location of olfactory receptors in insects: a review of experimental evidence 49

Mickel (Clarence E., M.Sc., Ph.D.). The Mutillid wasps of the Islands of the Pacific Ocean (Hymenoptera; Mutillidae) 177

Mosely (Martin E.). New Trichoptera and Plecoptera in France: some Auvergne Plecoptera 557

Myers (J. G., Sc.D.). Nesting associations of birds with social insects 11

Myers (J. G., Sc.D.). Ethological observations on the Citrus Bee, *Trigona silvestriana* Vachal, and other Neotropical bees (Hym., Apoidea) 131

Nixon (G. E. J., B.A.). A revision of the African Telenominae (Proctotrupoidea, fam. Scelionidae) 73

Potter (C., B.Sc.). The biology and distribution of *Rhizopertha dominica* (Fab.) 449

Richards (O. W., M.A., D.Sc.). Notes on the nomenclature of the Aculeate Hymenoptera, with special reference to British genera and species 143

Speyer (E. R., M.A.). The genus *Aptinothrips* Haliday (Thysanoptera: Terebrantia) 483

Warren (B. C. S.). Supplementary notes on the structural characteristics of *Pyrgus freija* (Warren, 1924) (Lep. Hesperiidae) ... 127

Williams (C. B., Sc.D.). The times of activity of certain nocturnal insects, chiefly Lepidoptera, as indicated by a light-trap 523

General Index 563

INSTRUCTIONS TO AUTHORS

Papers for publication in the Society's Transactions can only be communicated by a Fellow, and should be addressed to the Secretary at the Society's Rooms, 41 Queen's Gate, London, S.W. 7, *at least fourteen days* prior to the date of the Meeting at which it is proposed that such paper shall be read.

Authors are requested to write legibly on one side only of sheets of uniform size, and must number and fasten together the sheets ready for the printer. Any original drawings or illustrations must also be numbered and arranged ready for reproduction. Plates must be accompanied by plate descriptions written on separate sheets.

The size of work on plates should be limited to $7\frac{1}{2} \times 4\frac{3}{4}$ in.

Authors are reminded that, as the cost of plates is high and the subscription to the Society a very moderate one, papers requiring many plates may have to be refused unless the Author will contribute towards the cost of reproduction.

In the case of an Author presenting a paper with plates already partly reproduced at his expense, it must be understood that all subsequent orders in connection with their reproduction must come from the Society only.

A proof in galley slip will be sent to the Author and must be returned expeditiously. An average of sixteen shillings per sheet of 16 pp. is allowed for corrections, and it is to be distinctly understood that if this allowance be exceeded, the Author is liable for the difference. Any material alteration or addition made in the *paged* proof by an Author shall be made at his own expense, *and only through the Secretary*, even if he has not already exceeded the allowance of sixteen shillings per sheet.

Authors requiring more than the 25 free copies of their papers allowed by the Society must make their request when returning the first proofs. On the Council granting permission for such extra copies, the Author must pay the entire cost of them, proportionately to the total cost of the paper, subject to the discretion of the Council in exceptional cases.

TRANSACTIONS

OF THE

ROYAL

ENTOMOLOGICAL SOCIETY

OF LONDON

Vol. 83. 1935.

THE GENITAL STERNA OF THE IMMATURE STAGES OF *RHODNIUS PROLIXUS* (HEMIPTERA)

By J. D. Gillett.

(*Department of Entomology, London School of Hygiene and Tropical Medicine.*)

[Read 7th November, 1934.]

Introduction.

In view of the fact that *Rhodnius* is such an ideal insect for experimental research, a simple method by which the sexes could be distinguished in the nymph stages would, I feel, be of considerable value. It was with the object of ascertaining what differences exist in the genital segments of the nymphs that I have carried out this work.

In many insects rudiments of sexual characters are apparent when the insects are at quite an early stage of development. Indeed, in the locust *Nomadacris septemfasciata* the " upper valves " of the ovipositor in the female can be easily recognised in the first stage nymphs (Michelmore and Allen, 1934). Now in *Rhodnius* there is neither any external difference between the sexes, nor any external sign of developing genitalia until the third nymphal stage.

The Third Nymph Stage.

The sexual difference of the third nymph lies in the VIIIth sternite. The VIIth, IXth, and Xth sterna being the same in both sexes. The VIIIth sternite of both male and female bears a depression which, until one has examined it on many individuals, appears identical, but in reality the depression in the female is slightly smaller and its surface smoother than that in the male, which varies from a slight hollow with a wrinkled surface to a large moderately smooth depression.

On examining the living insect under the binocular dissecting microscope it is extremely difficult to differentiate between the two sexes of this stage, while on examining mounts in balsam under the microscope it is quite impossible.

THE FOURTH NYMPH STAGE.

The difference in the fourth nymph is a little more marked than that in the third, and although still minute it is, however, unlike that in the previous stage, quite distinct. Even at this stage no true sexual characters are visible, and it is not until the fifth or last nymphal stage that these make their appearance.

In the male fourth nymph the VIIth, or pregenital sternum (VII stn.), is not only unchanged from that of the third stage but is identical with that of the other sex (fig. 1A). The VIIIth and IXth, or genital sterna (VIII and IX stn.), also have not changed in form in the male, but in the female the depression on the VIIIth sternite (VIII stnt.) is surrounded by a ridge, and is invariably of a constant size (fig. 1B). The middle portion of the curved posterior margin of the VIIIth sternum is emarginated anteriorly allowing the ridge of the VIIIth sternite to protrude slightly over the IXth (fig. 1B). The depression on the corresponding position of the male varies from a flat wrinkled area to a large smooth depression, but is, however, never surrounded by a ridge (fig. 1A). The IXth sternite (IX stnt.) of the female is not so wide as that of the male and is much less rounded at the lateral margins, being cut away in an irregular fashion (fig. 1B). The Xth, or postgenital sternum (X stn.) is identical in both sexes, and is adapted to sheath the anus (fig. 1).

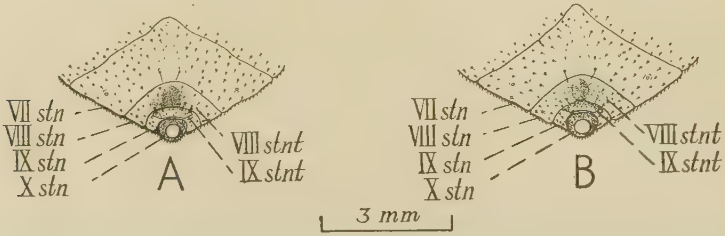


FIG. 1.—Terminal abdominal sterna of male and female fourth nymph stage of *Rhodnius prolixus*, showing VIIth–Xth sterna (VII–X stn.), and VIIIth and IXth sternites (VIII and IX stnt.). A.—male showing depression in the VIIIth sternite; B.—female showing smaller depression and surrounding ridge on VIIIth sternite, and slight anterior emargination of posterior margin of VIIIth sternum. Note the slight reduction in size and the difference in shape of the IXth sternite as compared with that of the male.

On examining the sexes of this stage under a binocular dissecting microscope it is almost impossible to see the difference in shape of the IXth sternite, but the difference in the VIIIth is quite clear. Conversely, on examination under the microscope of mounts in balsam the difference in shape of the IXth sternite is the deciding factor, while the depression on the VIIIth sternite is hardly discernible.

THE FIFTH NYMPH STAGE.

The VIIth, or pregenital sternum of the fifth nymph is, as in the previous stage, identical in both males and females, and moreover has not changed in form from that of the preceding stage (fig. 2). In the male the VIIIth, or first genital sternum, also has hardly changed its form (fig. 2A), but arising dorsally from the posterior margin of the IXth sternite are two lobe-like appendages (prl.), apparently homologous with the *paramere-lobes* of Homoptera nymphs (Singh-Pruthi, 1925) (fig. 2A). In the female fifth nymph the genital sterna, that is the VIIIth and IXth sterna have both altered in form (fig. 2B). The posterior margin of the VIIIth sternite is modified into a pair of sclerotised plates (I prm.), there being a small longitudinal division between the two (fig. 2B). The IXth sternite is very much reduced in size, and is fused to the preceding sternite, the point of fusion being between the two plates on that sternite. The IXth sternite bears two pairs of sclerotised plates (fig. 2B). The first pair (II prm.) being one on either side of the point of fusion of the two sternites, and the second pair of plates (III prm.) on the ventral edge of the posterior margin. As in the fourth stage the Xth, or postgenital sternum, is the same in both sexes, and is adapted to sheath the anus (fig. 2).

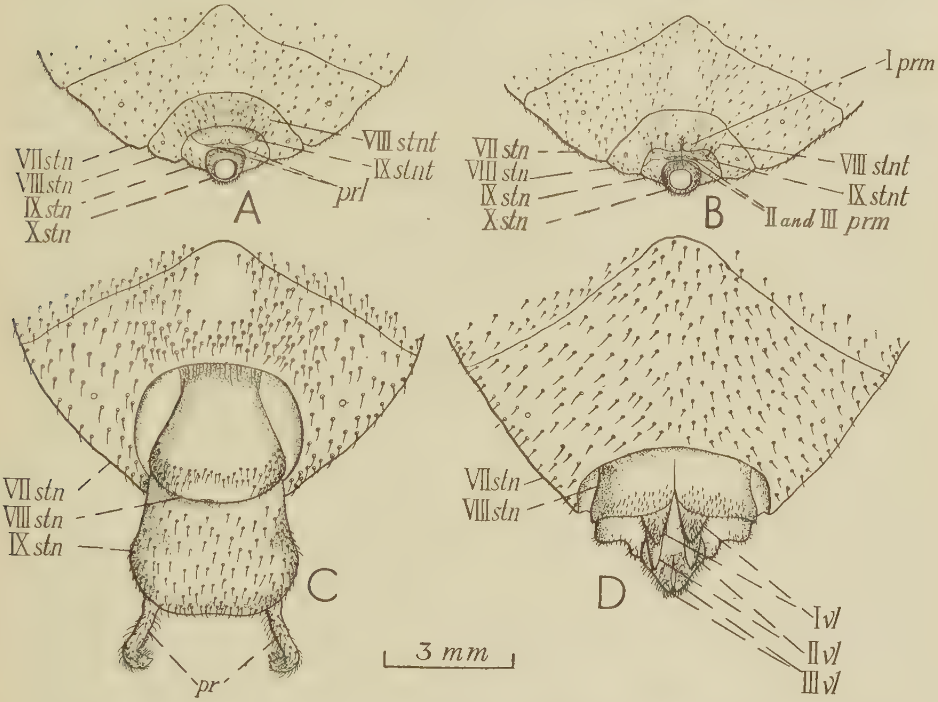


FIG. 2.—Terminal abdominal sterna of last two stages of male and female *Rhodnius prolixus*, showing VIIth–Xth sterna (VII–X stn.); and VIIIth and IXth sternites (VIII and IX stnt.). A.—male fifth nymph showing the "paramere-lobes" (prl.); B.—female fifth nymph showing division of VIIIth sternum and very much reduced IXth sternite. Note the three pairs of plates (I, II and III prm.) on the VIIIth and IXth sternites; C.—adult male with genital sterna extended showing parameres (pr.). The aedeagus is retracted; D.—adult female with valvulae extended (I, II and III vl.).

On examining under the binocular dissecting microscope the sexual differences in the living insect at this stage the chief points of distinction are, first the difference in size of the IXth sternite, and secondly, the division of the posterior margin of the VIIIth sternum in the female, with the pair of plates on either side. With good lighting it is possible to make out the second and third pairs of plates on the female, but the lobes on the IXth sternite of the male are visible only when prepared as mounts for examination under the microscope.

HOMOLOGY OF FOURTH AND FIFTH NYMPH AND ADULT *RHODNIUS*.

A homology of the segmental differences of the male and female fourth nymph with those of the male and female fifth nymph is by no means difficult, as there is comparatively little alteration in the segmental formation from one stage to the other.

The genital sterna of the male fifth nymph are almost the same as those of the fourth except for the disappearance of the depression on the VIIIth sternite and the addition of a pair of lobe-like structures on the posterior margin of the IXth. It is reasonable to suppose that the anterior emargination of the posterior margin of the VIIIth sternum of the female fourth nymph is the beginning of the small longitudinal division of the posterior margin of the same sternum in the female fifth nymph. Obviously the slight reduction in size and the difference in shape of the IXth sternite in the female fourth nymph is a step between the proportionately large IXth sternite of the third nymph and the very much reduced IXth sternite of the female fifth nymph.

In attempting to homologise the genital sterna of the fifth nymph with those of the adult it will be convenient to deal with each sex separately.

In the adult male the VIIth, or pregenital sternum, is extended backwards to a point posterior to the VIIIth, IXth and Xth sterna, and is there fused across the mid-line to enclose an opening through which the genital sterna, together with the anus, can be protruded (fig. 2C). The VIIIth, or first genital sternum, is about the same size in proportion to that in the previous stage, but it is bent round laterally to form a sheath for the IXth or second genital sternum (fig. 2C), and is mostly hidden by the VIIth. The IXth sternum is very much larger in proportion to that in the fifth nymph, but the anterior portion is covered by the VIIIth. This sternum, like the preceding one, is bent round laterally to enclose the aedeagus and the anus (fig. 2C). Arising from the intersegmental membrane of the IXth and Xth sterna are the parameres (pr.) (fig. 2C). It will be remembered that in the male fifth nymph the VIIIth sternum was devoid of all processes, while the IXth bore a pair of lobe-like structures (fig. 2A), which, if homologous with the paramere-lobes of Homoptera nymphs, will probably develop into both the parameres and the aedeagus.

The pregenital sternum of the adult female *Rhodnius* has not altered in form very much from that of the female fifth nymph (fig. 2D). The VIIIth sternum bears the first pair of gonapophyses, which form the first valvulae (I vl.) (fig. 2D). Along the median line of this sternum, that is, between each gonapophysis, the posterior margin is divided (fig. 2D), the division extending approximately two-thirds of the total width of the sternum.* Arising from the intersegmental membrane of the IXth and Xth sterna are the second and third valvulae (II and III vl.) (fig. 2D). In the female fifth nymph, as has been previously stated, there are three pairs of sclerotised plates, the first pair on the VIIIth sternite, and the second and third pairs on the IXth (fig. 2B). Kraepelin (1873), and Dewitz (1874–5), have described how there are on the immature females of most insects three pairs of conical outgrowths, one on the VIIIth sternum, and two on the IXth. The pair on the VIIIth develops into the first valvulae or ovipositor lobes, while those on the IXth develop into the second and third valvulae. Clearly these paired plates in the female fifth nymph of *Rhodnius* are homologous with the conical outgrowths, or primordia of some authors, mentioned above, and, therefore, will develop into the first, second and third valvulae of the adult female *Rhodnius*.

---

* It is of interest to note the gradual development of this fissure from its rudimentary form in the fourth nymph to its final form just described.

SUMMARY.

The males and females of *Rhodnius* nymphs cannot be distinguished until the third nymph stage. At this stage the difference is so minute that it is exceedingly difficult to distinguish them. The difference in the fourth stage is still slight, but the female may be identified in the following ways: (i) a depression on the VIIIth sternite surrounded by a ridge; (ii) a slight anterior emargination of the middle of the posterior margin of the VIIIth sternum, and (iii) a difference in shape of the IXth sternite. In the fifth or final nymph stage the sexes are easily recognisable by the differences in the VIIIth and IXth sternites, the male bearing a pair of lobe-like structures on the posterior margin of the IXth sternite, while the female has three pairs of sclerotised plates, the first on the posterior margin of the VIIIth sternite and the remaining two pairs on the IXth. I suggest that the lobes on the IXth sternite in the male will become the parameres and aedeagus of the adult male, and that the pair of plates on the VIIIth sternite of the female will become the first valvulae, while the two pairs of plates on the IXth will become the second and third valvulae of the adult female.

I wish here to express my thanks to Dr. V. B. Wigglesworth and Mr. A. C. Evans for many helpful suggestions.

REFERENCES.

DEWITZ, H. 1874–5. " Über Bau und Entwicklung des Stachels und der Legescheide einiger Hymenopteren und der grünen Heuschrecke." Z. wiss. Zool., **25** : 175–200.

KRAEPELIN, C. 1873. " Untersuchungen über den Bau Mechanismus und Entwicklungsgeschichte des Stachels der bienenartigen Thiere." Z. wiss. Zool., **23**.

MICHELMORE, A. P. G., and ALLEN, W. 1934. " Observations on phases of the Red-Winged locust in Northern Rhodesia." Bull. ent. Res., **25** : 101.

SINGH-PRUTHI, H. 1925. " The Development of the male genitalia of Homoptera, with preliminary remarks on the nature of these organs in other insects." Quart. J. Micr. Sci., **69** : 59.

ON THE BRUSH-ORGANS OF THE MALE *LITHOSIA GRISEOLA* HÜBN. (LEPIDOPTERA)

By H. Eltringham, M.A., D.Sc., F.R.S.

[Read 7th November, 1934.]

With Plate I.

I am indebted to my friend Mr. H. M. Edelsten for calling my attention to the remarkable brush-organs in the male *Lithosia griseola*, and for kindly supplying me with examples in fresh condition for microscopic examination. He informs me that he has long known of their existence, but it would appear that they have not been fully described previously.*

On carefully removing the cuticle from the posterior end of the abdomen, there can be seen, on the ventral surface, and just anterior to the bases of the claspers, a tuft of white hairs. The hairs are closely packed and radiate from a small area beneath the proximal end of the aedeagus. On either side of the brush there is a solid club-shaped organ, also white, arising from the same area as the brush-hairs, its distal, claviform end lying close to the bases of the claspers. This paired organ at once reminds one of the club-like organs associated with the defensive glands in females of the genus *Heliconius*, first observed by Müller, and more fully described in 1925, *Trans. ent. Soc. Lond.*, **1925 :** 269 *et seq.* They do not, however, appear to have any homology with these structures.

Plate I, fig. 1, shows a lateral view of the posterior end of the moth, after removal of the cuticle and relative membranes. At H are the claspers. A is the upper part of the aedeagus, on either side of which is a stout band of muscle-fibres M. Just beneath the muscle is a supporting rod of chitin R, and below this is seen the club-shaped organ C, and finally the brush B, which has been partially expanded by slight pressure of a needle applied to its base.

The claviform appendage is shown in section in fig. 2. It is formed by the fusion of a number of hairs, each of which is greatly expanded at its distal end. It is not glandular and shows no sign of being the reservoir for a secretion. There are no pores nor any special scales as in *Heliconius*. The contents resemble, and probably are, the somewhat flaky tissue often found in the interior of insect hairs. The separate hair-elements of which it is formed, though fused together distally, tend to separate easily at the proximal end. The organ seems to add one more to the increasing number of structures of which the histology is evident but the function obscure.

The hairs of the brush are very slender but slightly spatulate or claviform distally. They are of a pattern frequently found in brush-hairs, being delicately ribbed or fluted. Fig. 9 shows a transverse section and fig. 10 a longitudinal surface view of one of these hairs.

---

* My attention was first called to the "Brush" in *Lithosia griseola* in the following way. Some years ago I had succeeded in breeding numbers of these "Footmen" and had left some together to see if they would pair. On examining the cage afterwards I noticed that one of the dead males had the "Brush" protruding. The capture of some specimens at light at Wood Walton Fen this year gave the opportunity of further investigation, and Dr. Eltringham's most interesting paper is the result.—H.M.E.

To make clear the correlation of the brush to its adjacent membranes I have drawn a diagram, reproduced at fig. 3, representing a vertical longitudinal section. B represents the brush which is seen to arise from a membrane, M1. At its anterior or inner part whence the hairs arise, this membrane is much folded and wrinkled, and contains the hair-sockets which are of a very simple kind, and also numerous protoplasmic particles which stain uniformly black with haematoxylin. These particles would seem to be the remains of the trichogenic protoplasm. Fig. 5 shows a section through a small part of the membrane in this area. When we examine the posterior areas of the membrane, the structure is found to be rather different, fig. 7. It is still much folded, but is more regular and contains a greater number of dark-staining granules. There is no well-defined glandular structure, nor are there distinct cell divisions. Where, in my sections, occasional fragments of this part of the membrane appear in surface view, as at fig. 6, minute pores are visible, fig. 6 P,P. We must, I think, conclude that the membrane M1, fig. 3, is so modified that in its basal parts it produces the hairs, and, more distally, excretes the scent material, which, passing through the pores, impregnates the outer ends of the brush-hairs. Fig. 8 shows a small part of the secreting area in section. There are four protoplasmic granules, rather symmetrically arranged, and four of the secreting pores.

To return to fig. 3, the ventral surface of the brush is covered by another membrane, M2. Both membranes, M1 and M2, lie inside the external cuticle, C, and are doubtless eversible when the brush is protruded. The structure of the membrane M2 differs greatly from that of M1. Fig. 4 shows a small piece of it, one edge being folded over to show a part of the surface in profile. It is covered with minute nodules, and contains nuclear, or at least darkly-staining particles, in fairly regular rows. Its structure suggests that it is designed to afford the largest possible superficial area, and when everted it no doubt assists in the diffusion of the scent.

Lastly, if the brush be teased out on a slide, great numbers of minute spicules are found in a detached condition. On examination under a high power, these prove to be short lengths of slender hairs. Each length has rounded ends, and is evidently produced in this form from some of the trichogenic cells of the basal part of the membrane, M1, fig. 3. I have not been able to distinguish any corresponding differences in the trichogenic area of the membrane. A few of these spicules are illustrated in fig. 11. Their existence is extremely interesting, since they afford the first example of " dust-hairs " associated with brushes, in a British insect. Such dust material is frequently found in the brushes of exotic Lepidoptera, the best known example being that of *Amauris psyttalea*, described by me in 1915, *Trans. ent. Soc. Lond.*, **1915** : 152 *et seq.* The dust is supposed to assist in the diffusion of the scent. (See my *Senses of Insects*, 1933, p. 83.)

The brush-organs of *Lithosia griseola* are the most complicated yet observed in British Lepidoptera, and I would again express my indebtedness to Mr. Edelsten for the opportunity of describing them.

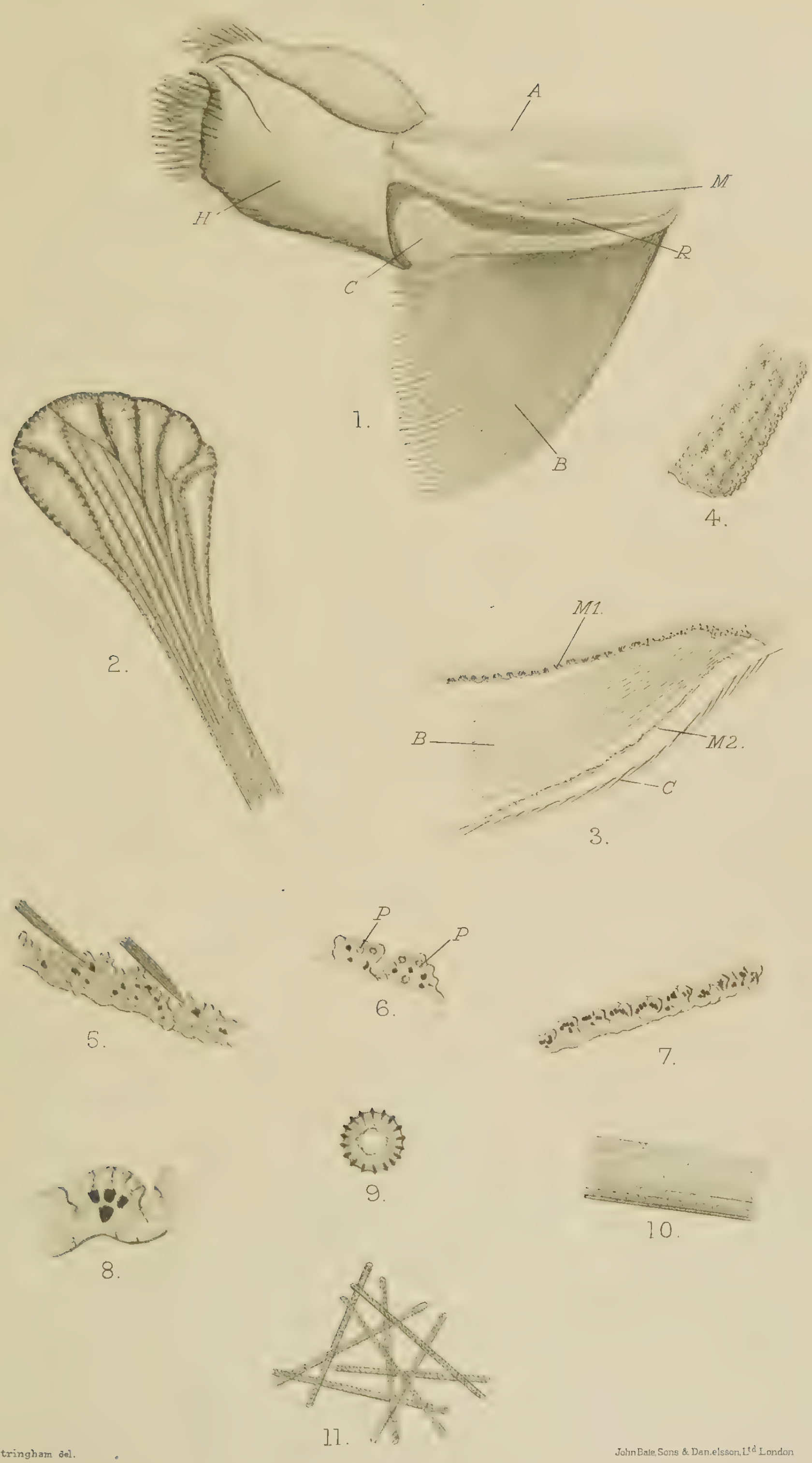
Since the above was written Mr. Edelsten has kindly sent me examples of three other species. Though not suitably preserved for microscopic examination, I have been able approximately to make out the corresponding structures. In *L. lurideola* the organs are similar but the claviform organ is more rudimentary. In *L. caniola* there are no claviform organs and the brush is but little developed. In *Cybosia mesomella* the brush is vestigial and can only just be recognised in the form of a few specialised hairs.

Explanation of Plate I.

Fig. 1. Anal portion of abdomen of male *Lithosia griseola*. A, part of aedeagus. H, clasper. C, claviform organ. B, brush. R, chitinous supporting rod. M, muscles.
2. Longitudinal section of terminal part of claviform organ.
3. Diagram to illustrate relative positions of brush and adjacent membranes. M1, the secreting membrane. B, brush. M2, covering membrane. C, ventral external cuticle.
4. Fragment of covering membrane (fig. 3, M2), highly magnified, to show nodular structure and nuclear bodies.
5. Section of secreting membrane (fig. 3, M1) at origin of brush hairs.
6. Fragment of secreting membrane from posterior part of same, showing pores, P,P.
7. Section of secreting membrane in posterior area.
8. An element of same, highly magnified, showing pores and protoplasmic granules.
9. Transverse section of a brush-hair.
10. Longitudinal surface view of same.
11. A few of the spicules or "dust-hairs," found in the brush.

Typical dimensions.

Least diameter of a brush-hair	·005 mm.
Maximum ditto	·02 mm.
Diameter of a dust-hair	·005 mm.
Greatest diameter of claviform organ	·4 mm.
Diameter of a pore in secreting membrane	·001 mm.


A
M
H
R
C
1.
B
4.
2.
M1.
B
M2.
C
3.
P
P
5.
6.
7.
9.
10.
8.
11.

H Eltringham del.
John Bale, Sons & Danielsson, L^td London

THE BRUSH ORGANS OF THE MALE *LITHOSIA GRISEOLA* HÜBN.

NESTING ASSOCIATIONS OF BIRDS WITH SOCIAL INSECTS

By J. G. Myers, Sc.D.

[Read 7th November, 1934.]

With Plate II.

Contents.

PAGE
1. Introduction 11
2. Association with Aculeate Hymenoptera 11
3. Association with Termites 16
4. Summary of Associations 17
5. Conclusions 19
References 21

1. Introduction.

In 1929 I published a short paper on the nesting together of birds, wasps and ants in South America. This stimulated notices of the same phenomenon from other parts of the world, and these, with further citations from the literature, and continued observations in South America and the West Indies, have served to show that these associations are much more widespread than generally supposed, and are much more definite and more regular. As it is impossible to dismiss them as in any sense random or accidental, the light they throw on certain aspects of bird and insect behaviour is very striking.

2. Association with Aculeate Hymenoptera.

Cacicus spp. *in the American tropics.*—These brilliantly-coloured and active birds, the yellow-backed oriole (*Cacicus cela*) and the red-rumped oriole (*C. haemorrhous*), were the chief subjects of my previous observations.

Beebe (1910, p. 204) published some notes of especial interest, since he was able to follow the history of a colony. Both species are markedly inclined to hang their woven, purse-shaped nests near human habitations. One may travel for miles through uninhabited country and see no *Cacicus* and finally reach some isolated Indian hut or other dwelling-place, with a noisy colony of *Cacicus* perhaps suspended from branches close over its roof. In the case observed by Beebe, at the Hoorie gold-workings on the Barima River, British Guiana, there were at first no nests of the red-rumped oriole nearer than 3½ miles away, where there was a two-year-old colony overhanging the house of a negro. In January a *Cacicus* was seen in the mine-clearing, but it soon disappeared. Within a few days several came, perhaps guided, says Beebe, by the solitary scout. These set to work at once and built a colony in an isolated tree, surrounded by water, and bearing nests of *Azteca* ants. (*Azteca chartifex* is the species usually observed in association with *Cacicus.*) Beebe remarks that the red-rumped oriole seems " to trust more " to the presence of man than to the " guardianship of wasps," but both forms of association occur.

Writing of the yellow-backed species (*C. cela*) in the same work (p. 33) Beebe says :—

"They showed a real intelligence in the selection of a site for their nests. Monkeys, tree-snakes, opossums and other bird-eating creatures were abundant hereabouts, and for a colony of these conspicuous birds to conceal their nests successfully would be impossible. So their homes are swung out in full view of all. But one or two precautions are always taken. Either the birds choose a solitary tree which fairly overhangs some thatched hut, or else the colony is clustered close about one of the great wasps' nests which are seen here and there high up among the branches of the forest. The Indians and native Venezuelans never trouble the birds, which have been quick to realise and take advantage of this fact, and weave their nests and care for their young almost within arm's reach of the thatched roof. No monkey dares venture here, and the mongrel dogs keep off all the small nocturnal carnivores. But a colony of Cassiques which chooses to live in the jungle itself, would have short shrift, were it not for the strange communal guardianship of the wasps. These insects are usually large and venomous, and one sting would be enough to kill a bird; indeed, a severe fever often ensues when a man has been stung by half a dozen. So the birds must in some way be immune to the attacks of the wasps. Perhaps their wonderfully complete armour of feathers, scales and horny beak accounts for this, while their quickness of vision and of action enables them to save their eyelids—their one unprotected spot. Although the Cassiques cannot have learned from experience of the terrible wounds which the wasps can inflict, yet they are keenly alive to the advantages to be derived from close association with them."

Beebe goes on to describe the nests as built so close together, as I myself have seen, "that the homes of insects and birds rattle against each other when the wind blows.

"Frequently when one or two of the big birds returned to their nests with a rush and a headlong plunge into the entrance, the whole branch shook violently. Yet the wasps showed no excitement or alarm; their subdued buzzing did not rise in tone. But when I reached up and moved the branch gently downward, the angry hum which came forth sent me into the underbrush in haste. From a safe distance I could see the wasps circling about in quick spurts which meant trouble to any intruder, while the excited Cassiques squeaked and screamed their loudest. Whether the slight motion I gave to the branch was unusual enough to arouse the insects, or whether they took their cue from the cries and actions of the alarmed birds, I cannot say."

According to my own observations, in Trinidad, the Guianas and Amazonia, the red-rumped species is less inclined to nest near wasps and ants than is the yellow-backed. Mixed colonies of the two birds are frequent. In the fights which then occasionally break out Beebe (*op. cit.*, p. 139) found that the red species was invariably the victor. This is curious since *C. cela* is the commoner, more widespread and ecologically dominant form. Of about 15 colonies observed with some attention since my first paper was written, three (one *haemorrhous*, two mixed) definitely had no wasp- nor ant-nests, while the other twelve contained large nests of one or both of these insects. Of these twelve, eight were pure colonies of *C. cela*, while four were mixed. It is surely highly significant that in no case have I seen a colony of *Cacicus* which was not (1) in a tree isolated by water or swamp, (2) very near to a house, (3) associated with wasp- and (or) ant-nests, or (4) showing a combination of these groupings. This is in marked contrast to the habit of the larger gregarious hang-nest (*Ostinops decumanus*) which enters into no such regular associations, with water, man or insect.

In the 1929 paper I have given evidence to show that the deliberate choice in the association is exhibited by the birds, and to a lesser degree by the wasps. In other words, the ants first found their colonies, and the birds select the vicinity for their nests. Where wasp-nests are present too, the wasps must have made a definite choice. Where the partners are wasps and birds only, it is the latter which have exerted the selection. Further evidence may be adduced here. In the Orinoco Delta a colony of *Cacicus cela*, of nine nests, mostly still in process of construction, with many fibres still green,—thus an obviously new colony—was grouped round a gigantic nest of *Polybia rejecta*, at least 2 feet long and 14 inches in diameter, and thus evidently of considerable age (pl. II, fig. 1).

In Guiana the usual wasp-associate of *Cacicus* is *Polybia rejecta*. On the lower Amazon, in a giant fig-tree, many nests of *C. cela* were thickly surrounded by branches and twigs beaded closely with numerous small, but very populous nests of the powerful larger wasp, *Polistes canadensis* var. *amazonica*. On the Rupununi River a small colony of *C. cela* was built in close proximity to a huge Meliponid nest, 3½ by 1½ feet in dimensions.

In some of the mixed colonies the nests of the two birds are so close together that the majority fuse and are actually confluent, forming huge fibrous masses a yard thick, with holes only marking the entrances of the individual nests.

The further adaptability and plasticity of *Cacicus* and of *Polybia* is shown by the fact that, whereas, on dry land, especially away from houses, trees of medium or great height are invariably chosen, in water and in soft bogs, colonies may be established on low suffruticose bushes.

It is significant that *Polybia rejecta*, whether in the presence or absence of birds, frequently builds its nest near that of other wasps. In the absence of specific evidence, I attribute the act of choice to the *Polybia* in view of its adaptable behaviour in other circumstances. Thus on the lower Amazon, at Santarem, in an isolated tree, growing out of water (in igapó or flooded forest), was a large nest of *P. rejecta*, and in close proximity a well-developed populous nest of the very vicious nocturnal wasp, *Apoica pallida*. Similarly, as shown above, *Polybia rejecta* often nests in the vicinity of large colonies of the numerous and vicious ant, *Azteca chartifex*. Thus, in Trinidad, I have seen six cases, in most of which it was self-evident that the *Azteca* nest was the older. Ducke (1910, p. 458) says that *Protopolybia emortualis* always lives in symbiosis with an ant of the genus *Dolichoderus*. This wasp, he states, is very timid and always leaves the defence of the nest to the ants, which are highly aggressive.

Other wasps seem sometimes definitely to choose the proximity of unrelated, but fiercely-stinging species as nest-sites. In one case, on the lower Amazon, a tiny, new nest of *Polistes canadensis* was sheltered just beneath a *Polybia* nest, the size of a child's head. An unidentified bird's nest, of the previous season, was built on an adjoining branch. In Trinidad, I found in a low tree a large and populous carton-nest of *Azteca chartifex* forming a real ant-garden, with a considerable *Ficus* shrub growing out of it, and several hanging-plants of the rare Bromeliad, *Aeranthes micrantha*. There were two succursal nests of the ant, one combined with a termite (*Nasutitermes* colony), but the most interesting feature was a small and obviously new nest of *Polistes pacificus* * with half a dozen cells, hanging to the undersurface of the large central ant-nest. The wasp-nest was attended by an adult. The ants were running over and in the cells and upon the eggs and young larvae, apparently without molesting them. Rau (1933, p. 121, fig. 57) records the large and virulent wasp *Synoeca surinama* nesting in close association with *Azteca* in Panama, but considers that since this powerful wasp is in little need of protection, " the ants must be the beneficiaries in this bargain." This view may, I think, be reconciled with mine on Müllerian grounds.

---

* I am indebted to Professor W. M. Wheeler and to Dr. J. Bequaert for identifying ant and wasp respectively.

TYRANNIDAE—*Birds nesting with wasps.*—In my 1929 paper I cited several observations on this family of birds. The following are new records :—

In Trinidad, a nest of *Pitangus sulphuratus* in proximity to two *Polybia rejecta* nests, in a saman tree (*Pithecolobium saman*); at Santarem, Amazon, in an igapó tree, over water, were six large *Polybia* nests and six birds' nests, mostly old, but one occupied by *Pitangus lictor,* there being neither bird-nest nor wasps', in adjacent trees; in the same locality a small catauari tree bore six large nests of *Polybia nigriceps*, five old birds' nests (an Icterid, a *Synallaxis* and three unidentified Tyrannids); again, in the same locality and in the same species of tree, were four large and populous nests of *Polybia nigriceps,* and, in close proximity, four nests, one occupied, of a small obscure Tyrannid; near Pará, Brazil, a nest of *Rhynchocyclus* sp., ready for eggs, was hung on the same horizontal branch, two feet from a large *Polybia* nest *; at Oriximiná, on the lower Amazon, a tall tree in the forest supported three large *Polybia* nests, and in the near vicinity, four untidy Tyrannid nests (some old), apparently *Pitangus sulphuratus*; in Trinidad, an old nest of *Fluvicola pica* was built two feet from a large occupied nest of *Polybia rejecta*, overhanging water; finally, at Corojo Pando, in the Venezuelan llanos, an 18-inch *Polybia* nest hung from the same branch of a small bush, with an occupied *Fluvicola* nest almost touching it.

SYNALLAXIDAE.—Two records of these birds nesting near wasp-nests were cited previously. The following is a new observation :—At Corojo Pando, Venezuela, an occupied *Polybia* nest (*P. occidentalis* var. *juruana* v. Ih., det. Dr. Bequaert) was suspended from the same branch just above a *Synallaxis* nest made entirely of exceedingly prickly twigs; an old wasp-nest of the same species hung two feet away.

COEREBIDAE.—The small birds of the genus *Coereba* are the most frequent sphecophiles of the West Indies. I previously cited one record. The following are new examples :—A small nest of *Coereba luteola* in a prickly lime-tree with a populous nest of *Polistes canadensis* hanging six inches away, from the same branch, and facing the entrance to the nest (Trinidad); at La Guaira, Venezuela, a *Coereba* nest with eggs, in a very spiny bush of *Acacia macracantha*, nearly touching two small occupied nests of *P. canadensis*; at Liguanea, Jamaica, a nest of *Coereba* in a very prickly *Acacia*, the bird sitting, surrounded within two feet, by no fewer than ten *Polistes* nests, a good proportion of which were old and abandoned, indicating an old colony; in the same locality, in a *Melicocca bijuga*, a *Coereba* nest completely surrounded by 57 medium-sized and small *Polistes* nests, *all occupied*, so that it was quite impossible to approach the nest; in both the above cases there were *no* wasp-nests in the adjacent trees; on La Gonave Island, Haiti, a *Coereba* nest high in a prickly mesquite (*Prosopis juliflora*), with a *Polistes* comb, the only one in the vicinity, hanging a few inches in front of the entrance †; at Picmi, La Gonave, an *old Coereba* nest, with a large occupied *Polistes* nest about a foot away. Gosse (1847, p. 85) states that the

---

[*] When my wife or I made a very slight disturbance the wasps massed on the outside of the nest, and on an increased shaking, a sharp rattling was heard, caused by the wasps, perhaps by rapping their abdomens on the outside casing of the nest. At this stage a half-dozen or so made direct and rapid sallies and we were both stung very painfully.

[†] Several other *Coereba* nests in similar bushes had no neighbouring wasp-nests.

nest of *Coereba flaveola* in Jamaica "is very frequently, perhaps usually, built in those low trees and bushes, from whose twigs depend the paper nests of the Brown Wasps, and in close contiguity with them."

[The passage continues :—

[" The Grass Quits are said to manifest the same predilection : it is a singular exercise of instinct, almost of reason ; for the object is doubtless the defence afforded by the presence of the formidable insects ; but upon what terms the league of amity is contracted between the neighbours, I am ignorant." Gosse also quotes, on p. 251, Mr. Hill's note concerning the "Yellow Face Grass-Quit" (*Spermophila olivacea*, L.). "It is quite true that the Grass-bird very frequently selects a shrub, on which the wasps have built, fixing the entrance close to their cells. I saw a nest in this secure situation a few years ago ; it was pointed out to me as illustrating a habit of the yellow-throated species."—E. B. P.]

Other birds.—Tremoleras (1929) figures a South American oven-bird (*Furnarius*) nest attached to an occupied wasp-nest. Kruger (1928) writing of the blue-breasted waxbill (*Uraeginthus angolensis*) in Natal, says that on the more open flats the nest is built near human habitations. "All the numerous nests observed have been built with the opening alongside a previously-built hornet's nest. The hornets are of a small red variety and do not appear to molest the birds." The following are personal observations, in the neotropics :—On the Venezuelan llanos, an open unidentified bird-nest in a very spiny *Acacia macracantha*, less than a foot from a large nest of *Polybia sericea* ; in Trinidad, in a prickly orange-tree, a nest of a thrush (*Planesticus* sp.) built on top of a hanging nest of *Azteca chartifex* (the ant-nest hanging beneath and the bird-nest resting on the branch) ; a nest of the blue tanager (*Thraupis sclateri*) with young in a very spiny orange-tree, within nine inches of a *Polybia* nest and close below several ant-gardens populated by vicious red ants, which swarmed over my arm and forced me into precipitate retreat (Trinidad) * ; also in Trinidad, a beautiful nest of the swift, *Panyptila cayenensis*, hanging from the branch of a saman over a frequented road. Within ten feet were a very large *Azteca* nest and two *Polybia* colonies ; Hasco, Haiti, a large mesquite, hanging over a house, was full of many hundreds of nests of the introduced weaver-bird, *Textor cucullatus*, mixed with an approximately equal number of large combs of a big *Polistes*—a chattering, seething mass in a tangle of prickly branches ; at Source Puantes, Haiti, a new colony of about a dozen nests of *Textor* in low mesquite, a *Polistes* comb hanging within a few inches of almost every nest, a few odd *Polistes* combs in adjacent bushes ; at Santa Marta, Colombia, a nest of the large wren (*Heleodytes* sp.), containing many pieces of large and small cast-skins of snakes, in a very thorny *Acacia macracantha*, with a medium-sized nest of *Polybia* sp. a few inches away ; in the same locality, another nest of the same bird in a tall tree near the road, with a much larger *Polybia*-nest close alongside.

An entirely analogous case, in which the venomous social insects are replaced by powerful raptorial birds, is recorded from Siberia and from North-east Greenland. Haviland (1926, p. 172) cites Popham as finding on the Yenisei River, that "each nest [of the red-breasted goose] was placed under a bluff occupied by a pair of buzzards or falcons, which assured the geese some protection from marauding foxes. This habit of the geese is well known to the Siberian settlers." Similarly bernicle geese, in North-east Greenland, were found (Manniche) nesting on rock-ledges with a nest of the gyrfalcon in the very middle of the colony. Haviland remarks on Jourdain's authority that in Spitzbergen the same goose "tries to escape the foxes by nesting on crags, and the goslings descend what is virtually a precipice to reach water." The bernicle goose thus resembles *Cacicus* and other sphecophilous birds in adopting additionally protected nesting-sites.

---

* Why are the young birds unmolested ?

In the following case it would appear as though the presence of wasps acted as a deterrent to nest-building. On the Kukenan River, near Mt. Roraima, I saw a *Falco sparverius*, a female, fly up and put its head and shoulders inside an old parrot—or woodpecker—hole in the stump of a dead aeta-palm (*Mauritia flexuosa*) and fly away again. Just inside the hole hung a populous nest of *Polistes canadensis*.

3. Association with Termites.

The nesting of certain birds actually inside occupied termitaria is a much better-known phenomenon, especially in Australia. In addition to those recorded in the *Proceedings of the Entomological Society* and summarised in the next section, the following records may be cited :—

In British Guiana, Hingston (1932, p. 72) mentions the pigmy Kingfisher (*Ceryle aenea*) which nests in arboreal termitaria. Barrington-Brown (1876, p. 154) found a nest of *Trogon melanopterus* in an arboreal termites nest. In Trinidad, *Psittacula viridissima*, according to Mr. G. D. Smooker, almost invariably nests in occupied nests of large termites, which bite badly. I have, however, known one instance of a nest in a hollow bamboo. Hegh (1922, p. 560, on the authority of Hagmann, 1907) mentions two Amazonian parrots, *Conurus aureus* Gm., and *Brotogerys virescens* Gm., which burrow into occupied arboreal termitaria. The entrance begins on the lower surface, and proceeds nearly vertically upwards to the rounded nest-cavity. Gosse (1847, p. 263) says that *Conurus flaviventer* (= *Eupsittula nana*) frequently nests in the habitations of termites ("duck ants") in the trees. Lloyd (1897, p. 1) similarly records, in Guiana, "*Tityra cayana*, one or two of the Trogons, and a small parrot (*Brotogerys* sp.)."

The common savannah parrakeet (*Conurus aeruginosus*) of the Rupununi and Rio Branco (British Guiana and northern Brazil) savannahs seems ordinarily to excavate its breeding burrows in the occupied spherical nests of arboreal termites, *Nasutitermes myersi* Snyder *. In the first case examined, found by Mr. Vesey FitzGerald, the entrance-hole was on one side of the lower surface, and led into a roundish cavity as large as a man's head, the termitary being largely hollowed-out, but still occupied, the aggressive nasute soldiers swarming out, especially from a new irregular annex, which looked as though it had been built after the parrot-invasion. Two lately abandoned nest-holes in termitaria of the same species, like the first in trees of *Curatella americana*, were found later. One nest which had evidently been the longer abandoned had the entrance-passage largely built up by the termites, and the whole fabric was occupied. One other nest-cavity had still an open entrance, but much new material had been built on the top and sides. The whole termitarium, including the walls of the cavity, was crowded with termites, and they swarmed out and covered my hands and arms with their sticky secretions. Later, when I broke up the nest-material itself, the workers became aggressive, and bit sharply, often leaving the head attached to my skin. The parrot-nest showed signs of recent use, and the sides of the lower part of the entrance passage were packed with fully-fed, white larvae and pupae of the maroon-coloured Pyralid moth (*Caphys*

---

* Described by Dr. T. A. Snyder.

bilineata Stoll.) * lying in termite galleries lined with white silk. There were more larvae than pupae, but also some empty pupa-cases. Termites were among but not within the silk-lined galleries. I saw no young larvae. May this be a case similar to that of the Australian parrot (*Psephotus chrysopterygius*) of similar habits, whose nestlings are kept clean of excreta by the larvae of a curious Oecophorid moth, *Neossiosynoeca scatophaga* Turner (Turner, 1933)? Later, on the Takutu River, I found a nest of *Conurus aeruginosus* in an arboreal termitarium of another *Nasutitermes*, which built pent-house-like structures up the trunk and main branches of a *Curatella*-tree.

Chubb (1916, p. 293) quotes Schomburgk (*Reis. Guian.*, **3** : 731) which is not available to me here, to the effect that the burrowing-owl (*Speotyto brachyptera*) utilises terrestrial termite-mounds, not nesting in its own excavations but in hollows made by armadillos and ant-eaters. According to my own observations, however, in the same Guiana savannahs, as well as in Santo Domingo and in the Bahamas, *Speotyto* digs its own burrows in the open savannah.

In contrast with the large earthy terrestrial termitaria, which are so frequently ripped open, in the South American savannahs, by the great ant-eater (*Myrmecophaga jubata*) and burrowed by armadillos, the round arboreal carton nests seem to be little molested. I presume they are occasionally broached by the tamanduá (*Tamandua tetradactyla* L.) but I know only two instances of birds breaking into them for other than nesting purposes. Bates (ed. 1892, p. 346) records at Ega, on the Amazon, " the barbets visiting every clayey nest of termites on the trees which lie in the line of march." In Trinidad, I once saw a pair of Dendrocolaptids (*Xiphorhynchus susurrans* Jardine) attacking a carton nest the size of a man's head, about fifteen feet up in a *Mabea* tree. One bird was picking open the side, with vigorous blows, while the other was engaged on the top where it was largely hidden from our view. Our attention was directed to them by the constant shower of fragments, pattering like rain on the leaves below.

4. SUMMARY OF ASSOCIATIONS.

In the following brief synopsis of the birds which have been observed to nest with wasps, bees, ants or termites I have added also those previously recorded. Even so, the list must still be very incomplete, and it is hoped that it will inspire other tropical observers to record their observations. An asterisk marks the more regular associations.

a. *Associating with Aculeate Hymenoptera.*

Crotophaga ani L., with *Polistes*, Trinidad.
Panyptila cayenensis Gm., with *Polistes, Polybia, Azteca*, S. America, Trinidad.
**Micropterus brachyurus*, 3 races, India, nesting regularly inside occupied nests of an aggressive ant, *Cremastogaster* sp. (Stuart Baker, quoted by Osmaston *in* Poulton, 1929).
Synallaxis sp., with *Polybia*, South America.
**Certhiaxis cinnamomea* Gm., with wasps, South America, Trinidad.
Furnarius sp., with wasps, South America.
**Fluvicola pica* Bodd., with *Polybia*, South America, Trinidad.
Tyrannus melancholicus Licht., with *Polistes canadensis*, Trinidad.
**Pitangus sulphuratus* L., with *Polybia*, South America.
Rhynchocyclus sp., with *Polybia*, South America.

---

* Determined by the Imperial Institute of Entomology.

**Heleodytes* sp., with *Polybia*, South America.
Planesticus sp., with *Azteca*, Trinidad.
**Gerygone*, several species, *Polistes*, and perhaps *Ropalidia*, Australia (Alexander).
**Coereba*, several spp., with *Polistes*, South America, West Indies.
Icterus xanthornus Gm., with *Polybia*, *Synoeca*, South America.
**Cacicus cela* L., with *Polistes*, *Polybia*, *Azteca* and Meliponids (also with *Apoica pallida*, *teste* Schultz), South America.
**Cacicus haemorrhous* L., with *Polistes*, *Polybia*, *Azteca*, South America.
Thraupis episcopus sclateri Berl., with large red stinging ant, Trinidad.
**Uraeginthus bengalus*, 4 races, with *Belonogaster griseus* F. (van Someren *in* Poulton, 1929; Belcher *in* Poulton, 1931).
**Uraeginthus angolensis niassensis* Reich., with *Belonogaster*, South Africa.
**Uraeginthus cyanocephalus* Richmond, with wasps, Africa (van Someren).
**Lagonosticta ruberrima* Reich., with *Belonogaster griseus* and another species of wasp, Africa (van Someren).
Lagonosticta senegalla, with wasps, Africa (Loveridge, 1923).
**Tiaris olivacea*, with *Polistes*, Jamaica (Gosse).
**Spermestes stigmatophora* Reich., with *Belonogaster griseus*, Africa (van Someren).
**Spermestes cucullatus* Swains., with *Belonogaster griseus*, Africa (van Someren).
**Ploceus megarhynchus*, with *Apis indica*, India (O'Donel).
**Textor cucullatus*, with *Polistes*, Haiti.
Corvus monedula, with *Apis mellifica*, England (Flintoff, Poulton, 1932).
**Leptocomia asiatica*, with wasps, India (Stuart Baker).
Aethopyga seheriae, with wasps, India (Stuart Baker).
**Dicaeum olivaceum*, with bees, India (Stuart Baker).
**Sauropatus chloris chloris*, with ants, India (Stuart Baker).
**Ploceëla chrysaea*, with wasps, India (Stuart Baker).
**Ploceus manyar*, with wasps, India (Stuart Baker).
Amadava amadava, with wasps, India (Stuart Baker).

b. *Associating with termites.*

**Psittacula viridissima* Lafr., Trinidad (G. D. Smooker).
**Brotogerys virescens* Gm., South America (Hagmann).
**Conurus aureus* Gm., South America (Hagmann).
**Conurus aeruginosus*, South America.
**Eupsittula nana* Vigors (*Conurus flaviventer* Gosse, *nec* Spix), Jamaica (Gosse).
**Psephotus pulcherrimus*, Australia.
**Psephotus chrysopterygius* Gould, Australia (Alexander and references).
**Psephotus dissimilis* Collett, Australia (Alexander and references).
Trogon spp., South America (Lloyd).
**Tanysiptera sylvia* Gould, Australia (Alexander and references).
**Dacelo gigas* Bodd., Australia (Alexander).
**Dacelo leachi* Vigors and Horsfield, Australia (Alexander).
**Halcyon pyrrhopygius* Gould, Australia (Alexander and references).
**Halcyon macleayi* Jardine and Selby, Australia (Alexander).
**Halcyon chloris* Bodd., Australia (Alexander).
**Halcyon sanctus* Vigors and Horsfield, Australia (Alexander).
(These last 6 Kingfishers are less regular associates than *Tanysiptera*.)
**Ceryle aenea*, Guiana (Hingston).
Tityra cayana, South America (Lloyd).

Myrmecocichla spp., Africa (Osmaston *in* Poulton, 1929). This is perhaps a doubtful case, since according to Belcher, these birds merely nest in cavities of old (often disused) termite mounds.

**Halcyon pileata*, India (Stuart Baker).

Sauropatus chloris chloris, India (Stuart Baker).

**Sauropatus chloris vidali*, India (Stuart Baker).

5. CONCLUSIONS.

The placing of an independent bird-nest near an Aculeate colony, or the building of a wasp-nest near an aggressive ant-society, is, of course, a habit different both in pattern and in result from the excavation of a nest actually inside a termitarium. The two phenomena will therefore be considered separately.

The association of so many species of birds, so regularly, with aggressive and venomous Hymenoptera, in all tropical regions, must certainly be due to a more definite factor than a mere random gregarious impulse. Yet it has been suggested to me, by a life-long student of the Aculeata, that nothing more is involved *. Were this the case, then we should expect that birds would place their nests much more frequently near termite-nests, for these are usually more abundant and conspicuous (cf. counts recorded in Myers, 1929). Actually, however, I have never seen a birds' nest built in close proximity to a termite colony. Moreover, the wasps, bees and ants frequented are all among the most vicious species. Of *Polybia rejecta*, for instance, Rau (1933, p. 78) states that " the most vivid impression that these wasps left was their pre-eminent ability to sting." There can be no doubt that association of birds with aculeates and of the latter *inter se*, corresponds to some definite ecological need, and I think we are justified in assuming that this need is protection. If, again, it is true that the danger from predatory enemies, ranging from insects to mammals, is much greater in the tropics than in the temperate zones, the first urge or instinct of a nest-building tropical bird must be to seek protection. In the vast majority of small and obscure species, this end is attained by a consummate art in hiding the nest, as anyone who has bird-nested in a tropical forest will agree. Others, again, like the larger raptorial and wading-birds, escape a whole series of smaller predators by their own size and means of defence. But there are others whose nests, either from their size and untidy appearance, or from a habit of building in colonies *, are exceedingly conspicuous and could not very well be hidden. It would in fact probably be impossible to conceal either a *Cacicus* colony or the huge untidy nest of a Kiskadee (*Pitangus sulphuratus*). Now it seems to me of great interest and significance that, of the eight neotropical † very regular (almost obligate) frequenters of wasps and ants, every one builds a nest which, through colony-formation or structure, or both, is exceedingly conspicuous, while the same applies to seven out of the nine neotropical less regular associates of aculeates. The two exceptions to the latter, namely, *Planesticus* and *Thraupis*, are very common birds, yet were seen nesting near Hymenoptera in only one instance each. It is significant again, that all the eight regular neotropical ant- and wasp-associates and five of the less regular ones, as though conscious of a special need for protecting their conspicuous nests, adopt usually (or at least frequently) one or more of the following additional devices, (*a*) nesting in colony (*Cacicus*, *Textor*, *Crotophaga*), (*b*) nesting near human habitations (*Cacicus*, *Textor*, *Panyptila*), (*c*) nesting in isolated trees over water (*Cacicus*, *Fluvicola*, *Certhiaxis*), (*d*) suspending the nest from a branch (*Cacicus*, *Icterus*, *Rhynchocyclus*), (*e*) nesting in thorny bushes (*Coereba*, *Textor*), (*f*) using thorny twigs in nest construction (*Synallaxis*), (*g*) using snake-skins in nest construction (*Heleodytes*, *Certhiaxis*).

---

* What I feel with some diffidence, to be even less probable, is the theory put forward by that great authority on South American social VESPIDAE, Dr. A. Ducke. In 1904 he found two nests of *Polybia occidentalis* Ol., " in places where there was an abundance of termite-nests, which they strongly resembled by the singular prolongations of the envelope, and by the irregular grouping of the combs, which were of different width. This is evidently one of those cases where the wasps manage to make their nest resemble those of other insects, abundant in the vicinity, a fact which I have already observed in *Polybia rejecta* and *Polybia lugubris*, whose nests, found in proximity to ant-nests, succeed in imitating the form of the latter " (Translation). This agrees with my observations that the wasps are the second-comers and have exercised the choice demanded, but the supposed nest-mimicry seems to me rather dubious, though I have had, of course, much less experience of neotropical wasp-nests than Dr. Ducke. But the latter goes much further than this when he states that the wasps also choose the proximity of *Cacicus* nests, and make their own structures imitate the shape of the birds' nests. Thus he writes (1910, p. 458) :—

" . . . la guêpe cherche toujours à imiter la forme des nids de ses voisins, donnant, selon le cas, à ses constructions une forme irrégulière, courte et large, qui imite les nids irrégulièrement sphériques des fourmis, ou une forme cylindrique très allongée imitant celle des nids du *Cassicus*. Ces observations nous prouvent, que ce sont les guêpes qui cherchent la protection des oiseaux ou des fourmis, et non vice-versa." I have seen no traces of such mimicry, which, in the case of the ant-nests, would be very difficult, since these vary so tremendously in size and shape. The nest of *Polybia rejecta* certainly varies considerably in length and size, with age, from short and wide to long and sausage-shaped, but always the shape of the extremities, the colour and the texture are very different from those of *Cacicus* nests. What, moreover, can the wasp do when it is a partner in a tripartite combination, with birds *and* with ants ?

It is risky to argue from the impressions of the human observer, but at the same time there is a frequent modern tendency to regard animals as incapable of co-ordinating their impressions and recognising some of them as warnings. In the *ensemble* of wasp-ant-bird nest, the latter, *i.e.* the non-dangerous element, is very frequently the most conspicuous, and without further examination the non-naturalist avoids the whole vicinity because of the ants and wasps which are probably adjacent ‡. There can be no valid objection to the assumption that those still more practical bush-workers, the forest animals themselves, act in the same way, however difficult it may be to prove. The nests of the wasps, with their often fragile paper cover, are, apart from their aggressive owners, probably the most easily damaged of the three structures §, and I agree with Mr. Collenette (*in* Poulton, 1931) that they might easily be injured by animals which stumbled on them inadvertently, as I have often done to my sorrow and as even the most experienced Indians sometimes do, when the wasps' nest is hanging in dense bush, with no ants' or birds' nests near. We can thus, I believe, explain the whole association on Müllerian and Batesian lines, all three partners receiving more protection than if nesting alone—the birds the most and the ants the least—while the bird-nests form the recognition-mark of the *ensemble*, the advertisement of danger.

How the habit has been built up is a question beyond the scope of this paper. I do not suggest that reasoning or even much intelligence is involved. The individual bird or wasp has come to regard the vicinity of wasps' or ants' nests

---

[*] This may be a means of protection against smaller predators—union is strength—while making the colony more conspicuous to larger enemies.

[†] I confine my remarks to the neotropical forms, with which alone I am thoroughly familiar in the field. *Textor* is, of course, introduced.

[‡] How often have my men, on the path ahead, drawn back and exclaimed: "Look out, Sir, dis bird always hab marabunta ! (= wasp)."

[§] Barrington Brown (1876, p. 253) once saw a large grey monkey knock down a wasps' nest, the context leaving one to suppose that this may have been by accident. This, however, may be an unusual occurrence. Chapman (1931) mentions a trogon of Panama attacking wasp-nests.

as a desirable site—it is probably a *Gestalt* phenomenon—the animal feels comfortable in that specific environment. How the species has acquired this habit is a deeper question which either Neodarwinians or Lamarckians might try to resolve, but the ontogenetic factor is surely a strong one—the wasp or bird brought up * in this association and thoroughly accustomed to contact with the other partners on terms of mutual tolerance, is surely more than likely to enter a similar association to build its own nest †.

The case of the termitophilous birds is simpler. In rain-forest areas with their moist conditions, and on wide plains with a scarcity of natural banks, the nests of arboreal and of earth-building termites respectively, offer well-sheltered, easily-bored sites for burrow-making birds. The advantage to the bird species is obvious. How far they receive further protection against invaders, afforded by the attacks of the soldier termites, is less certain. I have, however, described above the uncomfortable effects of their onslaught when opening a *Conurus* nest in a *Nasutitermes* colony. Probably this defence is adequate against certain types of natural enemies. The most interesting feature of the association, however, is the attitude of the termites. So far from their deriving any benefit, the whole central portion of the termitarium is frequently destroyed. One may apparently conclude that the termites are powerless to resist the invasion, which seems surprising in view of their numbers and aggressiveness. This is even more surprising in the case of the Oriental woodpecker (*Micropterus brachyurus*) which habitually excavates nesting-cavities in the nests of an aggressive ant, *Cremastogaster*, of much the same habits as the neotropical *Azteca*. It is impossible to conceive that the ants derive any benefit from the association, while the birds not only secure protection and shelter, but also feed freely on the ants. It would appear to be a simple case of nest-parasitism, but the powerlessness of the ants to resist is rather remarkable.

It is equally remarkable that, according to Stuart Baker, the eggs of these woodpeckers, when laid in ants' nests, " are in texture utterly unlike those of any other bird of the same family." They " are very soft, fragile and transparent," but when an individual *Micropterus* lays in an ordinary nest-hole instead of an ants' nest, its eggs " are far more like those characteristic of PICIDAE."

REFERENCES.

(I have not repeated all the references cited by the writers in the *Proc. ent. Soc. Lond.*, which should be consulted.)

ALEXANDER, W. B. 1931, Association of birds' nests with nests of insects in Australia. *Proc. ent. Soc. Lond.*, **5** : 111–114.

ANDRÉ, E. 1904, A naturalist in the Guianas. London.

BAKER, E. C. STUART. 1931, Nesting association between birds and wasps, ants, or termites, in the oriental Region. *Proc. ent. Soc. Lond.*, **6** : 34–37.

BATES, H. W. 1892 ed., The Naturalist on the River Amazon. London.

BEEBE, M. B. and C. W. 1910, Our search for a wilderness. New York.

BROWN, C. BARRINGTON. 1876, Canoe and camp life in British Guiana. xii + 400 pp., 10 pls., 1 map, London.

CHAPMAN, F. M. 1931, The Trogons of Barro Colorado, *Bird-Lore*, **33** : 105–107, 1 fig.

CHERRIE, G. K. 1930, Dark trails. xvi + 322 pp., 58 illus. and map, New York.

---

* A parallel case is afforded in the work of Schroeder, Craighead, Pictet and others, on feeding preferences of phytophagous insects which has shown the overwhelming importance of the larval nutritive medium as a factor in the selection of a host by the adult.

† To the above arguments the habit of *Micropterus*, which breeds in ant-nests, appears to offer several exceptions. It is discussed below.

Chubb, C. 1916–1921, The Birds of British Guiana. 2 vols., London.

Ducke, A. 1904, Sobre as Vespidas sociaes do Pará. *Bol. Mus. Goeldi*, **4** : 317–374, 4 figs.; 1. Supplemento. *ibid.*, **4** : 652–698, 1 fig.

Ducke, A. 1910, Revision des guêpes sociales polygames d'Amérique. *Ann. Mus. nat. Hung.*, **8** : 449–544, 17 figs.

Gosse, P. H. 1847, The Birds of Jamaica. London.

Hagmann, G. 1907, Die Vogelwelt der Insel Mexiana. *Zool. Jahrb.* (*Abt. Syst.*), **26** : 39.

Haviland, M. D. 1926, Forest, steppe and tundra. London.

Hegh, E. 1922, Les termites. Partie générale. Bruxelles.

Hingston, R. W. G. 1932, A naturalist in the Guiana Forest. London.

Kruger, N. D. 1928, Nesting of the blue-breasted waxbill, in the Tugela Valley, Natal. *Oologists' Rec.*, **8** : 83–84.

Lloyd, C. A. 1895, Some Guiana parrots. *Timehri*, (2) **9** : 270–278.

Loveridge, A. 1922, Notes on East African birds (chiefly nesting habits and stomach contents) collected 1915–1919. *Proc. zool. Soc. Lond.*, **1922** : 837 (quoted by van Someren, *in* Poulton, 1929).

Loveridge, A. 1923, Notes on East African birds (chiefly nesting habits and endoparasites) collected 1920–1923. *Proc. zool. Soc. Lond.*, **1923** : 899.

Myers, J. G. 1929, The nesting-together of birds, wasps and ants. *Proc. ent. Soc. Lond.*, **4** : 80–88.

O'Donel, H. V. 1934, On the nesting association between an Indian bird, *Ploceus megarhynchus*, and the jungle bee, *Apis indicus* Fabr. *Proc. ent. Soc. Lond.*, **8** : 137.

Poulton, E. B. 1929, [Remarks on the paper by Myers, 1929.] *Proc. ent. Soc. Lond.*, **4** : 88–90.

Poulton, E. B. 1930, The nesting association of birds and wasps. *Proc. ent. Soc. Lond.*, **5** : 44.

Poulton, E. B. 1931*a*, Lantern illustrations of associations between Australian birds and wasps or termites. *Proc. ent. Soc. Lond.*, **6** : 37.

Poulton, E. B. 1931*b*, Association of birds' nests with nests of insects. *Proc. ent. Soc. Lond.*, **6** : 54–56.

Poulton, E. B. 1932*a*, Hive-bees occupying a hole in a chestnut tree in which a jackdaw was nesting. *Proc. ent. Soc. Lond.*, **6** : 82.

Poulton, E. B. 1932*b*, Further evidence of nesting associations between neotropical birds and wasps. *Proc. ent. Soc. Lond.*, **7** : 55–56.

Rau, P. 1933, Jungle bees and wasps of Barro Colorado Island (Panama). Kirkwood, Mo.

Tremoleras, J. 1929, [Descr. and fig. Oven-bird's nest attached to an occupied wasps' nest.] *El Hornero, Buenos Aires*, 4. [1930, *Bird Lore*, **32** : 369, mention.]

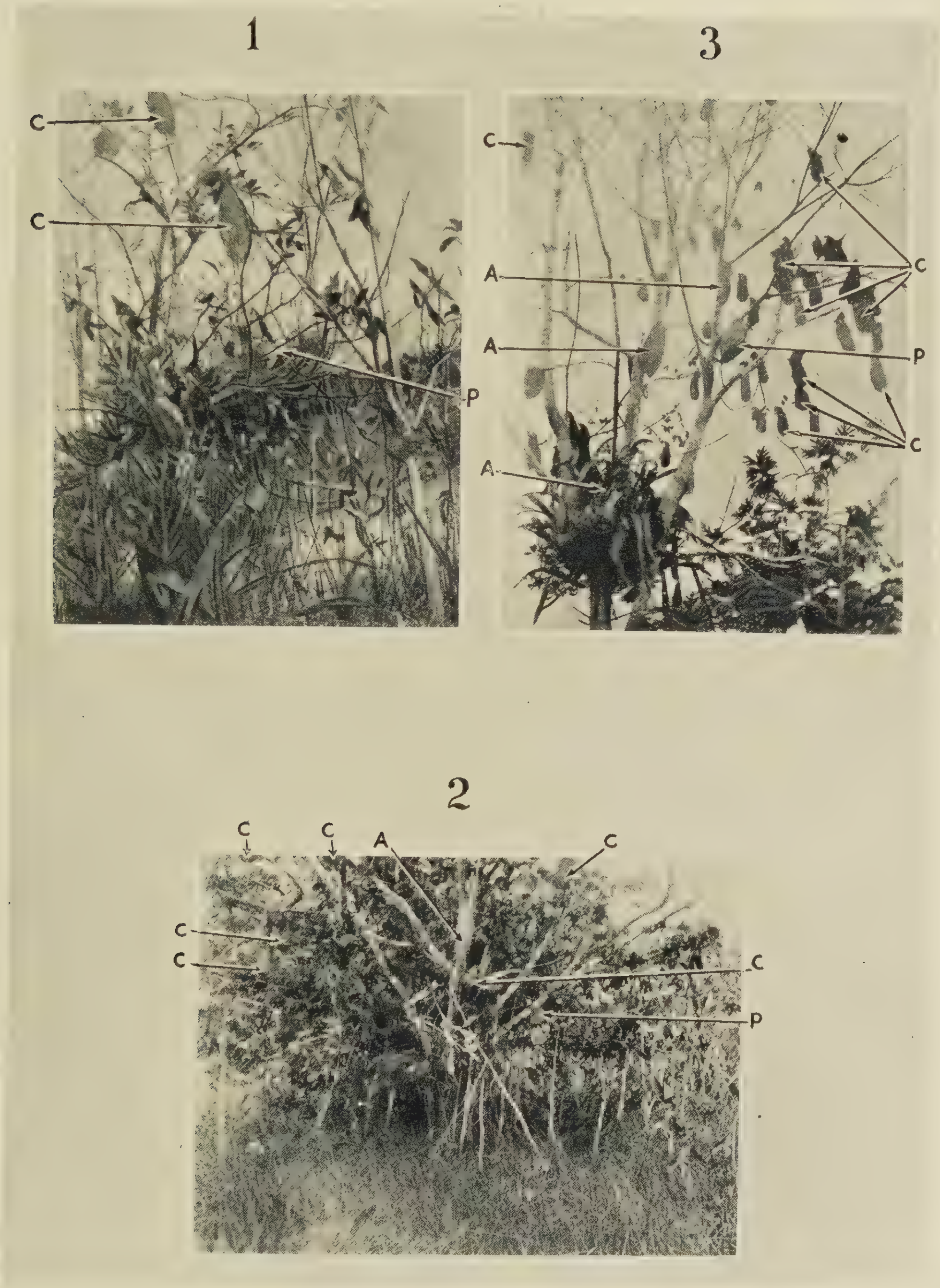
Turner, A. J. 1923, A Lepidopterous scavenger living in parrots' nests. *Trans. ent. Soc. Lond.*, **1923** : 170–175.

Explanation of Plate II.

Fig. 1. *Cacicus cela* (C) nesting with *Polybia rejecta* (P) (the large nest indistinct in the background) in wet savannah, Orinoco Delta. Photo, I. H. Myers. The loose texture shown in the original photograph indicates that the lower *Cacicus* nest is unfinished. Several wasps, clustered on the nest (P), are seen as black dots in the photograph, and two or three of them can be detected in the print.

2. *Cacicus* colony (C) with *Azteca* nests (A) and *Polybia* nest (P), in wet savannah, Orinoco Delta. Photo, I. H. Myers.

3. Mixed colony, *Cacicus cela* and *C. haemorrhous* (both C), about 90 nests, with a large nest (P) of *Polybia rejecta* and an extensive colony of *Azteca chartifex* (A) (in the Bromeliad, with several succursals, of which two are indicated by (A), on the bare branches) in tree of *Hevea brasiliensis*, N.W. District, British Guiana. Photo, T. W. Whittingham. The nests of the two species of *Cacicus* are quite indistinguishable. The main ants' nest is almost completely hidden within and behind the base of the Bromeliad.



1. **Nests (C) of Yellow-backed Oriole** (*Cacicus cela*) **with large nest (P) of wasp** (*Polybia rejecta*) **: Orinoco Delta. I. H. Myers.**
2. **Colony of Oriole** (*Cacicus*) **nests (C) with nest (A) of ant** (*Azteca*) **and (P) of wasp** (*Polybia*) **: Orinoco Delta. I. H. Myers.**
3. **Mixed colony of nests (C) of 2 Orioles with large nest (P) of wasp** (*Polybia rejecta*) **and extensive colony of ant** (*Azteca chartifex*) **nests (A) : N.W. Dist. Brit. Guiana. T. W. Whittingham.**

THE HIGH MOUNTAIN SAWFLIES OF BRITAIN (HYMENOPTERA SYMPHYTA)

By Robert B. Benson, M.A.

(*Department of Entomology, British Museum* (*Nat. Hist.*).)

[Read 7th November, 1934.]

Introduction.

(1) The account that follows is concerned primarily with the sawflies of the high mountain regions of the British Isles, especially those few species which seem to be associated with the plants belonging to the arctic–alpine element of our flora (Tansley 1911).

Zoologically and even more especially entomologically these high mountains in Britain are as yet largely unexplored. Admittedly the difficulties in the way of making any comprehensive survey are very great; apart from the vast areas to be studied, and the great distances to be traversed over rough, often tractless, moorland country before the summits can be reached, the weather is constantly upsetting one's plans. To the entomologist everything is dependent on the weather. Not only are the insects on the wing for such a short season and apparently so capricious in their choice of habitats, but also they are quick to hide away in the tangled dwarf vegetation of the mountain top when the sun goes behind a cloud or the wind blows chill.

This account, then, can make no pretence of being complete, as there are probably many more species to be added when the regions are further explored. In most other groups the fauna is hardly any better known and should provide an interesting field for anyone keen enough to undertake the exploration. Our collecting was done mostly in the Breadalbane Mountains in June 1931 and June 1932, and in the Cairn Gorms in June 1934, on all three occasions with the help of certain of my colleagues at the British Museum, and on the last occasion also with that of my wife. All the specimens obtained have been placed in the collections of the British Museum (Natural History).

Besides adding a few insects new to science and others to the British list, the collecting and studying of this material has enabled me to identify and interpret a number of obscure types of species, in bad condition, described from Scottish material by Cameron.

It is not my purpose here to list all the species that have been found on the mountain tops, but to limit my remarks to those few species that I believe to be native to, and especially associated with, these regions. For this reason I have excluded such species as *Acantholyda pinivora* Enslin, a female of which came and settled on a piece of orange that Mr. Tams was eating on the top of Ben Lawers on 18 June 1932. The host-plant of this species is larch and it had evidently been carried up by the wind. Such instances are common; a female of *Dolerus haematodes* Schrank settled on the cairn at the top of Benmore beside Dr. F. W. Edwards. Many of the insects collected by W. S. Bruce at the summit of Ben Nevis when he was stationed at the observatory there, were also undoubtedly carried up by the wind; one of these, a male of *Selandria wüstnei* Konow, which was recorded by Morice (1896) as new to Britain was the only known

British example of this species until we found it in the Spey Valley in June 1934. Such occurrences on the mountain tops are purely accidental, and in no way indicate that the species are native to the high regions.

Likewise I have not included species which appear to have found their way to higher regions by following streams. Several lowland species of willow, for example, do in favoured places extend well above the 2000-foot line, and have carried with them their associated sawfly fauna; these sawflies I have excluded unless they appear to have definite affinities with high-mountain or northern forms. At the same time I have also excluded such species as *Dolerus scoticus* Cameron (= *articola* Kiaer) which, though clearly northern or arctic forms, do not regularly occur high up on the mountains, but mostly only low down in the glens. Nevertheless a few lowland forms closely allied to high-mountain ones had to be introduced for purposes of comparison. All species marked with an asterisk * are additions to the British list.

(2) *The affinities of the Scotch arctic sawfly fauna.*

The Scotch arctic sawfly fauna as a whole appears to show several affinities with that described recently by Malaise (1920–1921) from arctic Lapland, though of course it is not nearly so rich in species. Kiaer studied the sawflies of Norway and in 1902 ably summarised what was known about the arctic sawflies of the world. When the mountains of Norway are further explored they will probably be found to possess a fauna linking that of Scotland with that of Lapland. Some of the species are already known to occur also in the high mountains of central and southern Europe, but much work yet remains to be done in these regions. Some also are already known to occur right across Siberia to Kamtchatka, but too little comparative work has yet been done with the North American arctic species, nor have they yet been sufficiently collected to say whether they also are represented in Europe or not.

(3) *Mouthpart and Genitalia Studies.*

A study of the mouthparts and the genitalia has been made of all the species considered, and, wherever possible, the results have been used for systematic purposes. The mouthparts have been found sometimes to be of value in determining the generic position of a species. *Amauronematus* and *Pteronidea* run very close to each other and are often difficult to separate, but in *Amauronematus* it is found that the stipes of the maxilla is often elongate, but even when this is not so the maxillary palp is shorter than the combined length of the cardo and stipes of the maxilla; in *Pteronidea*, on the other hand, the maxillary palp is usually elongate in at any rate the third segment, so that the total length of the palp is longer than the combined length of cardo and stipes of the maxilla. The saws and male genitalia are useful for separating species in some groups, but in others they show a similar though characteristic form throughout. The gall-making *Pontania* species, for instance, have very similar saws, which, as a group, distinguish them at once from the non-gall-making genera *Amauronematus* and *Pteronidea*. The form of the penis-valves of the genitalia has proved a useful character in the males, and has the additional advantage that it can often be examined without dissection.

(4) *Acknowledgments.*

My thanks are due to several of my colleagues at the British Museum who accompanied me on these trips and who, by collecting specimens for me at different times or at differents places from where I was able to go myself, enabled me to extend the scope of my survey.

My thanks are also due to Dr. R. Forsius (Finland), Dr. R. Malaise (Sweden), and Dr. H. H. Ross (U.S.A.) for examining, comparing and lending me specimens.

Finally my thanks are specially due to the Trustees of the Godman Fund, whose interest in this work and whose financial assistance enabled me to make longer visits to the highlands than would otherwise have been possible.

(5) *The species considered.*

Dolerus aeneus Hartig.

Dolerus aeneus Hartig, 1837, Adelfl. Deutschl. : 241; Enslin 1913, Tenthred. Mitteleurop. (1912–18), **2** : 179, etc.

This almost ubiquitous species is the only *Dolerus* met with on the high mountains and is, I believe, native to them. I have seen it frequently above 3000 ft. in the Breadalbane Mountains and above 4000 ft. in the Cairn Gorms. Long series taken high up in Breadalbane in June 1932 show surprising variation; many specimens have lost almost all trace of the rugulous sculpture on the abdomen so that they appear to belong to some melanic form of one of the red species until one sees the short hairs to the cerci.

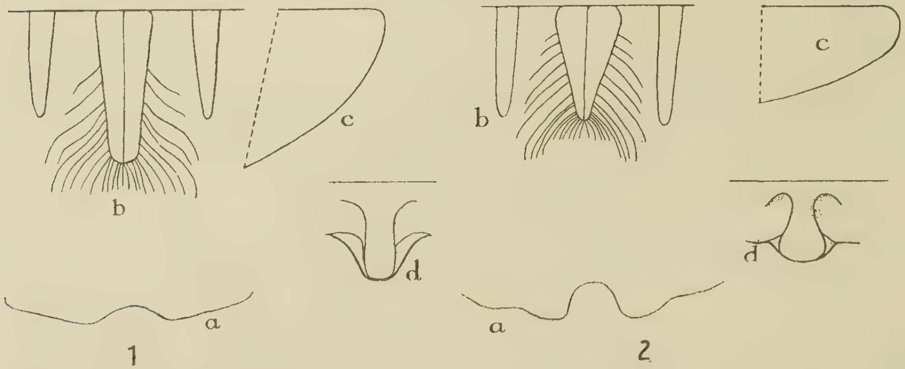
Enslin records finding this species up to a height of 2500 metres in the Alps. It is widely distributed and common throughout Europe except in the extreme South, and is probably one of the germanic species that came in from Asia after the retreat of the glacial epoch and has since adapted itself to life on the high mountains. It is not therefore truly arctic, as most of the species dealt with appear to be, since it is not of preglacial origin, having survived the extent of greatest glaciation on the mountains above the ice. But it is not possible, with our present insufficient knowledge of the distribution of species, to deduce the centres of origin and dispersal of any of them for certain. Those interested in this question of survival through the glacial epoch should refer to Scharff (1907), and Wilmott (1930), and contrast with these the view expressed by Salisbury (1932).

Pontania pustulator Forsius.

Nematus vesicator Bremi, Cameron *nec* Bremi, 1885, Mon. Brit. Phyt. Hym., **2** : 183–4. *Pontania pustulator* Forsius, 1923, Notul. ent., Helsingf., **3** : 51; Harrison, 1926, Vasculum, **12** : 116–117.

This species was described from specimens obtained in Finland, and was found first in Britain by Cameron at Rannoch in Perthshire, and recorded by him as *P. vesicator* (Bremi), with which species it was confused until Forsius separated them in 1923. Prof. J. W. Heslop Harrison, F.R.S., has since then found and recorded the species in Upper Teesdale. The galls of this species occur only on *Salix phylicifolia* L., and resemble those of *P. viminalis* (L.). It is single brooded, whereas *P. vesicator* is double brooded and occurs on the willows allied to *S. purpurea* L. I have seen no British specimen of *P. vesicator* and do not know that it has ever been taken in Britain. I am indebted to Dr. Forsius for the specimens of both these species from which I have made the comparisons. The differences between the two species are shown in figures 1a–d, and 2a–d.

The saws and male genitalia show very poor differences between the several species of gall-making *Pontania*. The saws of some of the species have been figured by Cameron (1885). The male genitalia are similar to those of *Pontania herbaceae* (Cameron).



Figs. 1–2.—(1) *Pontania pustulator* Forsius. (2) *P. vesicator* (Bremi): (a) clypeus; (b) ♀ sawsheath from above; (c) ♀ sawsheath from the side; (d) apical projection of ♂ abdominal tergum 8.

Pontania phylicifoliae Forsius.

Pontania phylicifoliae Forsius, 1920, Med. Soc. Fauna Fl. fenn., **45** : 165; Harrison, 1926, Vasculum **12** : 116–117.
P. viminalis L. var. *heptimaculae* Malaise, 1920, Ent. Tidskr., **61** : 115 and fig. 15.
P. heptimaculae Malaise, 1931, Skr. svensk. Vetensk. Akad., **17** : 61; Forsius, 1932, Notul. ent., **12** : 16.

The galls of this species have been found by Prof. J. W. Heslop Harrison on *Salix phylicifolia* L. in Upper Teesdale and Alston (Cumberland). The insects are close to *P. viminalis* (L.), from which they are separated by the pale unicolorous stigma and the narrow sawsheath viewed from above. Malaise (1920) figures the sawsheaths of both these species (cf. Malaise figs. 14 and 15).

Pontania robbinsi nom. n.

Nematus femoralis Zaddach, Cameron *nec* Zaddach, 1875, Proc. nat. Hist. Soc. Glasgow, **2**: 295 etc.
N. ischnocerus C. G. Thomson, Cameron *nec* C. G. Thomson, 1885, Mon. Brit. Phyt. Hym., **2** : 195, and *gall* pl. 26, fig. 3; Trail, 1883, Trans. Perthsh. Soc. nat. Sci., **1** : 212–3, 1888, Trans. bot. Soc. Edinb., **16** : 212–3, and 1889, *Ibid.*, **17** : 435–6.
Pontania femoralis Cameron, Enslin, 1915, Tenthred. Mitteleurop. (1912–18), **3** : 363–4 and *gall* Abb. 98; Harrison, 1922, Vasculum, **9** : 30 and 1932, *Ibid.*, **18** : 112; Malaise, 1931, Skr. svensk. Vetensk. Akad., **17** : 61 and 1931, Ark. Zool., **23** A (8) : 35.

The peculiar elongate and generally twinned galls of this species were first discovered and bred by Cameron in Scotland, but incorrectly determined by him. The species is now known also in Scandinavia (Trail, Malaise). Enslin speaks of the species as being not rare in Europe in mountains and also on the sea coast. In Britain it has been found by Trail in Aberdeenshire (Braemar), and Cameron in Perthshire (Rannoch) and Kirkcudbrightshire (New Galloway); Prof. J. W. Heslop Harrison found it in Teesdale.

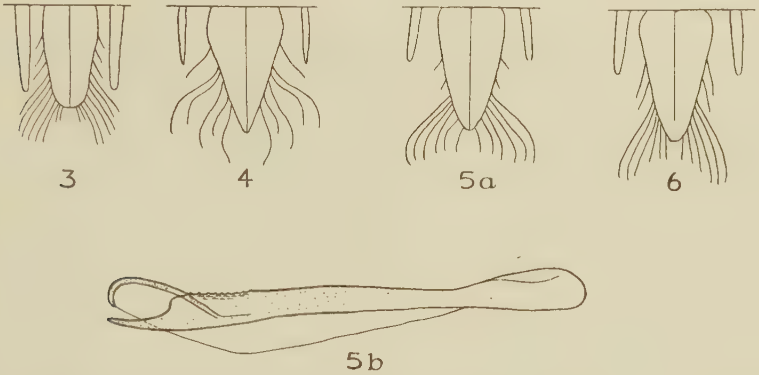
Unfortunately in Britain the name *Pontania femoralis* (Cameron) has been frequently applied wrongly to forms of *Pontania proxima* Lep., with dark hind femora in recent years.

Originally it was described from galls on *Salix purpurea* L., and x. *S. laurina* (Sm.); galls were found later by Trail on *Salix nigricans* Sm., *S. purpurea* L., *S. phylicifolia* L., *S. arbuscula* L. and *S. lapponum* L., var. *stuartina*;

and by Harrison on *S. phylicifolia* L. and x. *S. andersoniana* (Sm.) as very rare on *S. aurita* L., and also on x. *S. purpurea* L. Malaise in 1931 recorded it from *S. sachalinensis* F. Schm. at Kamtchatka, East Siberia.

This species is on the wing as early as April, and the larvae are full grown by the end of June or July. For fresh specimens of this species I am indebted to Prof. J. W. Heslop Harrison and Mr. J. Wilkinson who sent me some galls from near Riding Mill, Yorkshire, from which I was able to breed a series of adults.

In general form the female of this species is close to that of *Pontania proxima* (Le Peletier), but the sawsheath viewed from the side is shorter than the length of the second to the seventh abdominal terga, and the cerci are very long, reaching back about as far as the sawsheath does (fig. 3); while in the female of *P. proxima* the sawsheath, viewed from the side, is longer than the length of the second to the seventh abdominal terga, and the cerci are much shorter (fig. 4).



Figs. 3–6.—(3) ♀ sawsheath of *P. robbinsi* nom. n., from above. (4) ♀ sawsheath of *P. proxima* (Lep.), from above. (5) *P. herbaceae* (Cameron): (a) ♀ sawsheath from above; (b) ♂ penis-valve. (6) ♀ sawsheath of *P. polaris* Malaise.

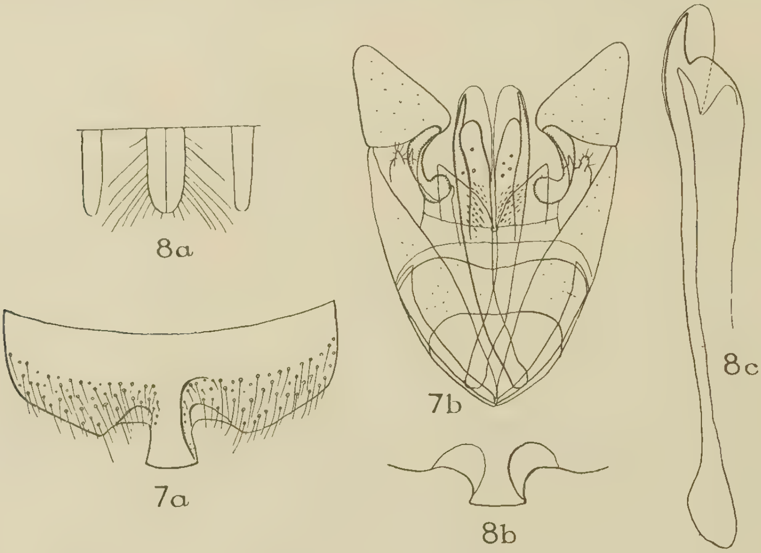
I am naming this interesting species after my late friend John Cuthbert Robbins, whose tragic death cut short the life of a young and promising student of the sawflies.

Pontania herbaceae (Cameron).

Nematus sp. Inchbald, 1868, Ent. mon. Mag., **5** : 21.
N. herbaceae Cameron, 1875, Proc. nat. Hist. Soc. Glasgow, **2** : 304–307; 1885, Mon. Brit. Phyt. Hym., **2** : 205 and pl. 3, fig. 8, *gall* pl. 9, fig. 3, and *saw* pl. 26, fig. 7.

This is a locally abundant species on *Salix herbaceae* L., but also occurs on *S. arbuscula* L. in Britain. The species was first noticed by Inchbald on Grassmoor in Cumberland. Cameron recorded the species from Sutherlandshire, Perthshire (Breadalbane Mountains, Rannoch, Ben Ledi), Aberdeenshire (Braemar), in Scotland, and Cumberland (Allonby) in England. I have found it myself abundantly in the Breadalbane Mountains and Cairn Gorms and have had it brought to me from the Lake District, Cumberland, by the late J. C. Robbins and my colleague Dr. F. W. Edwards, while Mr. Britten told me he has noted the galls high up on Snowdon, so that no doubt it is present on all our higher mountains. On the crags above Lochan à Lairige in Perthshire in June 1932 I found specimens visiting the male catkins of *Salix arbuscula*;

my colleague Dr. G. Taylor very kindly examined these willows for me later in the same year and brought some galls from which I bred a series of specimens slightly larger than the average size but undoubtedly conspecific. About the distribution outside Britain it is impossible to speak with confidence owing to the confusion with the next species *Pontania polaris* Mal. These two species can be distinguished in the female by the arrangement of the hairs on the sawsheath when viewed from above (figs. 5 and 6); the galls, however, are apparently identical. The male genitalia of all the *Pontania* species studied are very like that figured for *Pteronidea forsiusi* (Enslin) (fig. 7b), but the penis-valve is like that in figure 5b. Malaise's species recorded from Sweden in 1920 is not this species to judge from specimens he has presented to the British Museum, but are, I think, possibly the same species as his *P. polaris* Malaise.



Figs. 7–8.—(7) *Pteronidea forsiusi* (Enslin): (a) ♂ abdominal tergum 8; (b) ♂ genitalia. (8) *P. nubium* sp. n.: (a) ♀ sawsheath from above; (b) apical projection of ♂ abdominal tergum 8; (c) ♂ penis-valve.

The species recorded from Norway, Hammerfest, by Trail (1889, *Trans. bot. Soc. Edinb.*, **17** : 486) and from Spain, Nuria, by Harrison (1926, *Vasculum*, **12** : 14) no doubt belong either to the present species or the one that follows.

* *Pontania polaris* Malaise.

? *Pontania reticulatae* Malaise, 1920, Ent. Tidskr., **51** : 109, *gall* fig. 8.
? *Pontania herbaceae* Cameron, Malaise *nec* Cameron, *loc. cit.* : 110–111.
P. polaris Malaise, *loc. cit.* : 112, *gall* fig. 10.

This species was bred by Malaise from galls not distinguished from those of his *Pontania herbaceae* (Cameron) Malaise *nec* Cameron on *Salix herbacea* L., *S. polaris* L. and hybrids in Swedish Lapland. I found a few females of this species mixed with the specimens of *P. herbaceae* Cameron obtained from catkins of *Salix herbacea* on Meall nà Samhne, Perthshire, June 1932. The other host plant *S. polaris* is not found in Britain.

This species can be separated from *P. herbaceae* in the female, by the arrangement of the hairs on the sawsheath when viewed from above (figs. 5 and 6).

Pontania herbaceae (Cameron) Malaise *nec* Cameron is, I believe, the same species. The difference of the head sculpture is so very variable in my specimens of *P. polaris* Malaise from Scotland, that they seem to include both forms together with intermediates; similar variation occurs also in *P. herbaceae. P. reticulatae* Malaise is so close to *P. polaris* that it is only distinguishable on host plant and gall characters; the gall grows only from the underside of the leaf of *Salix reticulata* L., instead of extending equally on both sides of the leaf as it does on *Salix polaris* and *herbacea*; this difference is, I believe, due only to the different texture and thickness of the leaf of *Salix reticulata.*

If *P. polaris* and *P. reticulatae* prove to be synonymous, then *P. reticulatae* has page priority.

Pontania lapponica Malaise is also very closely allied and may be synonymous with this or the preceding species.

* *Pteronidea forsiusi* (Enslin).

Pontania forsiusi Enslin, 1915, Tenthred. Mitteleurop. (1912–18), **4** : 354–5; Forsius, 1921, Medd Soc. Fauna Fl. fenn., **46** : 29–30; Malaise, 1931, Skr. svensk. Vetensk. Akad., **17** : 60.

I have found this species on most of the high mountains in the Breadalbane and the Cairn Gorm ranges; on the continent it is known only from Sweden and Finland. In Scotland it is particularly partial to the flowers of *Alchemilla alpina* L. above 2000 ft., but is also to be found flying over *Vaccinium.* Females put in a tube with leaves of *Vaccinium* readily oviposited all over the leaves, placing their kidney-shaped eggs just under the surface epidermis, much in the way that such species as *Pteronidea curtispina* (C. G. Thomson) do on *Salix.*

Enslin described this species as a *Pontania*; but it is clearly not a gall-maker and is far better placed in *Pteronidea* together with *Amauronematus alberich* Benson (1934) from Bear Island. They are better placed in *Pteronidea* than in *Amauronematus* not only on account of their slight puncturation, but also on account of their mouthparts. In the introduction I have already pointed out and summarised the differences between *Pteronidea* and *Amauronematus* as shown by a study of their mouthparts, particularly the maxilla.

In *Pteronidea forsiusi* (Enslin) and *P. alberich* (Benson) the stipes is short as in *Pteronidea,* while the palp is long, segments 3–6 being elongated. The saw of this species is very similar to that of *Pteronidea alberich* * and of a number of other species of *Pteronidea* and *Amauronematus.*

The male has been described briefly by Forsius, 1921; a further description follows :—

♂ *Colour* : black except for the hind temples obscurely, the hind tibia, the front of the fore and middle tibiae and tarsi, and the hypopygium which are brown. Wings hyaline; stigma brownish-yellow sometimes with a darker margin; venation brown.

Length 4·7 mm.; antenna 3·5 mm.; fore-wing 5 mm.

Structure as in female except for anal segments; tergum 8 smooth, punctured and pubescent only on sides of hind margin, as in figure 7a; male genitalia (fig. 7b) is also characteristic of several other species of *Pteronidea, Pontania* and *Amauronematus.*

SCOTLAND : Perthshire, Sheihallion, above 2500 ft., 10 ♂♂ 13.vi.1931 (*W. H. T. Tams*); Inverness-shire, Cairn Gorm Mountains, Lairig Ghru above

---

* *Pontania ciccum* Konow, and *P. tenuitarsis* Konow, probably also belong to the same group; an examination of their saws will reveal at once whether they are true gall-makers or not. If they are not true gall-makers they would be better placed in *Pteronidea.*

2000 ft., 5 ♂♂ 10.vi.1934 and 33 ♂♂ 12.vi.1934 (*R. B.* and *J. E. Benson*); Inverness-shire, Cairn Gorm, above 3000 ft., 2 ♂♂ 29.vi.1934 (*R. B.* and *J. E. B.*).

Pteronidea nubium sp. n.

♀♂ *Colour*: entirely black except for the tibiae of all legs, the tarsi of the fore and middle legs and the cerci and, in the female, tergum 9 which are brown. Wings hyaline; stigma brownish-yellow apically, white basally; venation brown.

Length ♀ 4–5 mm.; antenna 2·5–3 mm.; wing 5–5·5 mm. ♂ 5 mm.; antenna 3·2 mm.; wing 4·5 mm.

♀ *Structure*: shining all over and unpunctured except for vague rugulous sculpture on face, head, and abdomen and strong irregular rugulous sculpture on pronotum and metanotum.

Pubescence evenly distributed all over except for dorsum of abdomen. *Head*: parallel sided; maxilla with stipes longer than cardo; clypeus with the front marginal excision long and shallow; frontal area raised but not clearly margined at the sides, smooth and rounded; median fovea clearly marked, elongate but open behind; post-ocellar area three times as broad as long and with well-marked vertical furrows each side; antennal segment 3 curved and shorter than 4 but about equal to 5 in length; sawsheath narrow, parallel sided, rounded behind with straight hairs down side (fig. 8a); cerci reaching as far back as sawsheath; saw as in *P. forsiusi* (Enslin).

♂ as in ♀ except for anal segments; tergum 8 slightly punctured all over with median apical projection as in fig. 8b; genitalia as in *Pteronidea forsiusi* (fig. 7b) except for the penis-valve which is figured separately (fig. 8c).

SCOTLAND: Perthshire, Breadalbane Mountains, above 2000 ft., 1 ♀ (Holotype) 7–14.vi.1932 (*R. B. Benson*); Perthshire, Meall nà Samhne, above 2500 ft. 2 ♀♀ 16.vi.1932 (*R. B. B.*); Inverness-shire, Mount Braeriach, 4000 ft., 1 ♂ (Allotype), 1 ♀, 25.vi.1934 (*R. B.* and *J. E. Benson*).

This species is unlike any other known *Pteronidea*; in Enslin's key (1916, *Tenthred. Mitteleurop.* (1912–18) **5**: 425) it would run to *P. capito* Konow, but, among other things, the sawsheath is entirely different from that species. In general appearance it is more like a *Pontania*, and superficially resembles *Pontania polaris* Malaise. The specimens were taken from catkins of *Salix herbacea* L., which is probably its food plant.

* *Amauronematus abnormis* (Holmgren).

Nematus abnormis Holmgren, 1883, Ent. Tidskr., **4**: 148; Konow, 1903, Z. Hym. Dipt., **3**: 157.
Amauronematus abnormis Holmgren, Malaise, 1920, Ent. Tidskr., **61**: 124–125 (redescription of ♀).

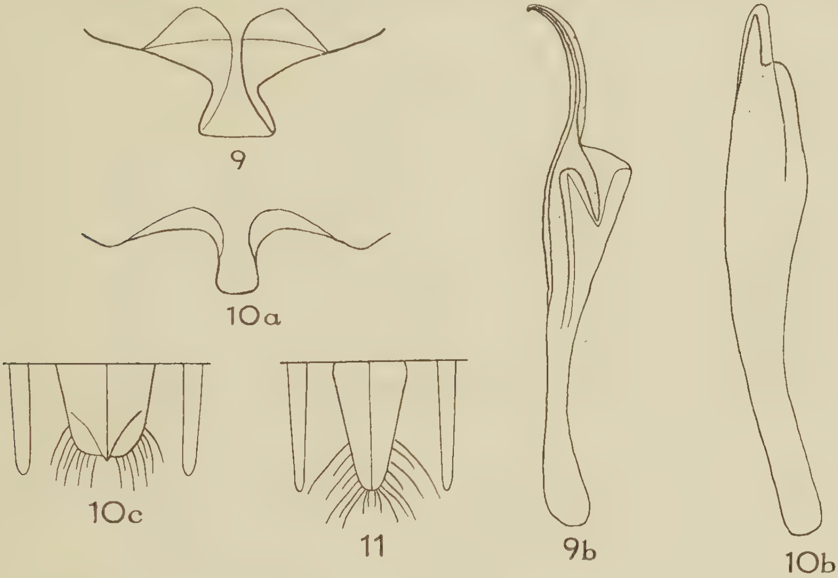
A series (10 ♂♂, 21 ♀♀) of this interesting insect was taken crawling over *Salix herbacea* L., at about 4000 ft. near the Einich Cairn of Mount Braeriach, Inverness-shire, on 25.vi. and 2.vii.1934. This is one of the very few known species of sawflies in which brachyptery occurs, the females in this case having wings generally abnormal in shape and venation, and variable in length but clearly shorter than the length of the abdomen. The species was originally described briefly by Holmgren from three females captured in Novaya Zemlya, but the existence of such a species was not accepted by Konow as the description seemed to him to be "lediglich Fantasie." He said the specimens were probably abnormal examples of *Loderus genucinctus* Zaddach.

In 1907 Konow himself described another *Amauronematus* with a brachypterous female (*A. tolli* Konow) from the New Siberian Islands.

After the Novaya Zemlya specimens were taken *Amauronematus abnormis*

(Holmgren) had not been found or examined again until Malaise caught a single female, the fourth known specimen, at 1000 m. on the mountain heath of Snuoratjokko, north of the Torne Träsk, in Swedish Lapland, and redescribed the species in detail in 1920, so that the occurrence of both males and females of this species in some abundance on the top of Mount Braeriach in Scotland is of especial interest. A description of the male, which has not been described before, is given below :—

♂ *Colour* : all black except for the tibiae of all legs and the basal tarsal segments of the fore and middle legs which are brown. Wings hyaline, stigma and costa yellow ; venation brown. *Structure* as in ♀ except for the wings which are of normal length and of typical *Amauronematus* venation, and for the anal segments. The projection to tergum 8 is illustrated in figure 9a ; the male genitalia are very like those of *Pteronidea forsiusi* (Enslin) (fig. 7b) but the penis-valve is illustrated in figure 9b.



Figs. 9–11.—(9) *Amauronematus abnormis* (Holmgren) : (a) apical projection of ♂ abdominal tergum 8 ; (b) ♂ penis-valve. (10) *A. mcluckiei* sp. n. : (a) apical projection of ♂ abdominal tergum 8 ; (b) ♂ penis-valve ; (c) ♀ sawsheath from above. (11) ♀ sawsheath of *A. alsius* sp. n., from above.

Length 5–5·5 mm. ; fore-wing 5 mm. ; antenna 3·5 mm.

Scotland : Inverness-shire, Mount Braeriach, 4000 ft., 8 ♂♂ (including Allotype), 25.vi.1934, 2 ♂♂, 21 ♀♀, 2.vii.1934 (*R. B.* and *J. E. Benson*).

Amauronematus mcluckiei sp. n.

♀ *Colour* : in the holotype entirely black except the following which are brown : the anal terga 9 and 10, the knees and tibiae of fore and middle legs, the apex of the tibiae of hind legs together with underside of basal tarsal segments of all legs ; in some of the paratypes there is a brown spot also on the temple behind the eyes and sometimes extending down the side of the face, and sometimes brown also are the tegulae, the hind margin of the pronotum, the apices of the femora, the whole of the tibiae and tarsal segments. Wings hyaline ; stigma yellowish-white ; venation brown.

Length 5–6 mm.; fore-wing 5–5·5 mm.; antenna 3 mm.

Head and thorax dull with squamose or coriaceous surface; abdomen shining but with coriaceous surface sculpture. Pubescence sparse and short, absent from dorsum of abdomen. Head narrowed behind the eyes; mouthparts normal, with long stipes, and maxillary palp shorter than stipes and cardo together; clypeus with a broad shallow emargination in front; antennae with segment 3 shorter than 4 and 5, but equal in length to 6; median fovea continuing back as a groove, open behind; frontal area raised slightly and rounded, but not clearly defined.

Sawsheath almost parallel sided when viewed from above, rounded behind, just perceptibly produced in the middle, reaching back about as far as the cerci (fig. 10a); saw as in *Pteronidea forsiusi* (Enslin), etc., see above.

♂ *Colour* as in ♀ but the hypopygium behind and the genitalia also are brown. *Structure* as in ♀ except for anal segments. Projection to tergum is illustrated in figure 10b; the genitalia very similar to that of *Pteronidea forsiusi* etc., but the penis-valve is illustrated in figure 10c.

Length 5 mm.; fore-wing 5 mm.; antenna 4 mm.

SCOTLAND: Inverness-shire: Cairn Gorm, above 3000 ft., 1 ♂ (Allotype), 4 ♀♀ (including Holotype) 27.vi.1934, 1 ♀ 29.vi.1934 (*R. B.* and *J. E. Benson*); Mount Braeriach, 4000 ft., 2 ♂♂, 1 ♀, 25.vi.1934. Perthshire, Breadalbane Mountains, above 2500 ft., 11 ♂♂, 29 ♀♀, 31.v. to 6.vi.1932 (*R. B. B.*).

It was found most frequently crawling over stones and rocks, as, for example, on the cairn at the very top of Ben Lawers, but also taken at catkins of *Salix herbacea* L. which is probably its food plant.

Of previously described species the new species is apparently close in structure to *A. zetterstedti* Malaise 1920 of Lapland, but this is a differently coloured insect with a dark brown stigma, and with white hind margins to the abdominal terga.

From *A. variabilis* Malaise (1931, *Ark. Zool.*, **23**, A (8) : 42–44), of Kamtchatka, it differs through its longer cerci and more strongly punctured head. While of the other Kamtchatka species, *A. latisulcatus* Malaise has a stigma pale in the middle with a dark margin and *A. terminalis* Malaise has a different saw with very fine teeth.

I have named this species after my wife.

Amauronematus alsius sp. n.

♀ *Colour* reddish-yellow; black or fuscous are the sutures between most of the sclerites, the funicle and pedicellum of antenna, the pro-episternum, the metanotum, the middle of the abdominal tergum 1, terga 2–7 except at the sides and the hind margins, and the sawsheath. Wings hyaline; stigma pale yellow; venation brown.

Length 5·5 mm.; fore-wing 6 mm.; antenna 3·5 mm.

Puncturation: surface somewhat shining; head and thorax with shallow irregular rugulous puncturing all over; dorsum of abdomen with coriaceous surface.

Structure: head parallel sided; maxillary palps short; stipes of maxilla longer than cardo; clypeus with only a shallow broad emargination in front; median fovea in the form of a groove, closed behind; frontal area with a keeled margin; vertical furrows clearly defined; antennal segment 3 shorter than 4 and equal to 5 in length; sawsheath about four times as broad as cerci at base, narrowing behind where it is rounded (fig. 11); cerci long, reaching as far back as sawsheath; saw as in *Pteronidea forsiusi* (Enslin).

SCOTLAND: Inverness-shire, Cairn Gorm Mountains, Lairig Ghru, above 2000 ft., 2 ♀♀ (including Holotype), 10.vi.1934 (*R. B.* and *J. E. Benson*).

This species is superficially like *Pteronidea forsiusi*, but is larger and has the *Amauronematus* puncturation. It was captured with this species on *Vaccinium*, which is probably its food plant.

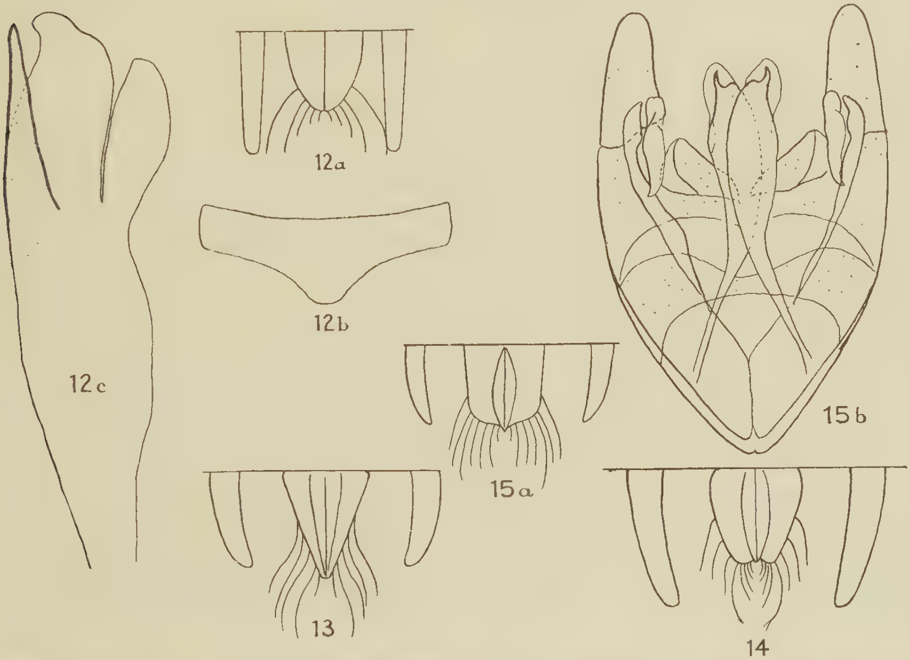
It is also superficially like *A. leptocephalus* (Thomson) from Lapland, but in that species the sawsheath is much narrower, being scarcely wider than the cerci, and it is characterised by a head which is strongly emarginate behind so that it appears very short when viewed from above.

Pachynematus clibrichellus (Cameron).

Nematus hyperboreus Cameron *nec* C. G. Thomson, 1878, Faun. Scotland : 32, ♀, *N. clibrichellus* Cameron, *ibid.*, ♂.

N. thomsoni Cameron, 1882, Trans. ent. Soc. Lond., **1882** : 540, nom. n. for *N. hyberboreus* Cameron *nec* Thomson.

N. clibrichensis Cameron, 1884, Mon. Brit. Phyt. Hym., **2** : 88, emend. pro *N. clibrichellus* Cameron. *Pachynematus clibrichensis* Cameron 1892, *op. cit.* **4** : 200.



Figs. 12–15.—(12) *Pachynematus clibrichellus* (Cameron) : (a) ♀ sawsheath from above; (b) ♂ tergum 8; (c) ♂ penis-valve. (13) ♀ sawsheath of *Lygaeonematus carinatus* (Hartig) from above. (14) ♀ sawsheath of *L. mollis* (Hartig) from above. (15) *L. coactulus* (Ruthe) : (a) ♀ sawsheath from above; (b) ♂ genitalia.

This species occurs above 2500 ft., and we found it generally distributed in Perthshire and Inverness-shire in June wherever we collected. Heretofore it has been known only from the single male type which Cameron collected high up on Mount Clibrich, in Sutherlandshire, and from the single female collected by Dr. Sharp at Braemar, in Aberdeenshire. There is no doubt that these two specimens belong to the same species.

The species is allied to *Pachynematus moerens* Förster, and has, like that species, mesopleurae shining between the hair-bearing warts, but is characterised in the female by having a broad rounded sawsheath appearing, from above, considerably shorter than the cerci (fig. 12a), and in having, in the male, a large triangular projection to the apex of tergum 8 (fig. 12b).

The penis-valve of the male genitalia is illustrated in figure 12c.

In *P. moerens*, the sawsheath in the female reaches beyond the cerci, and the eighth tergum in the male has a very short projection in the middle less in length than the length of the rest of the segment.

Pachynematus obductus (Hartig).

Nematus obductus Hartig, 1837, Adelfl. Deutschl., **1** : 201.
N. graminis Cameron, 1874, Ent. mon. Mag., **10** : 221.
Pachynematus obductus (Hartig) Enslin, 1916, Tenthred. Mitteleurop. (1912–18), **5** : 466–467, etc.

This species is common throughout northern Europe, occurring even in Iceland, but it is not limited to arctic or mountain conditions. It seems partial to the flower of *Alchemilla alpina* L., extending its range up to 3000 ft., in many of the mountains of Perthshire and Inverness-shire.

Lygaeonematus mollis (Hartig).

Nematus mollis Hartig, 1837, Adelfl. Deutschl., **1** : 201.
N. mollis Hartig, Cameron, 1885, Mon. Brit. Phyt. Hym., **2** : 74, *saw* pl. xvii, fig. 1.
Lygaeonematus mollis (Hartig), Enslin, 1916, Tenthred. Mitteleurop. (1912–18), **5** : 509–510, etc.

This species occurs in the glens early in the year, but later occurs right at the very top of the mountains. The larva feeds on *Vaccinium* and the species is found throughout northern and central Europe. It can be distinguished from other closely allied species by the well-defined keeled frontal area on the head, bearing just in front of the front ocellus a smooth unpunctured spot and by the entirely black abdomen. For the sawsheath see fig. 14. The saw is illustrated by Cameron.

Lygaeonematus carinatus Hartig.

Tenthredo pallipes Fallén *nec* Spinola, 1808, K. Vetensk. Acad. Nya. Handl., **29** (2) : 110.
Nematus pallipes (Fallén) Dahlbom *nec* Le Peletier, 1835, Conspect. Tenthred : 7.
N. carinatus Hartig, 1837, Adelfl. Deutschl., **1** : 199.
Lygaeonematus pallipes (Fallén), Enslin, 1916, Tenthred. Mitteleurop. (1912–1917), **2** : 512.

This species was taken near Braemar, Aberdeenshire, 27.v.1931, by Mr. P. Harwood. It is close to *L. coactulus* (Ruthe), but the female has a very distinctive sawsheath narrowed behind and acuminate (fig. 13); the saw, and the male genitalia and last apical segment are apparently not distinguishable from that of *L. coactulus* with the small amount of material I have been able to examine.

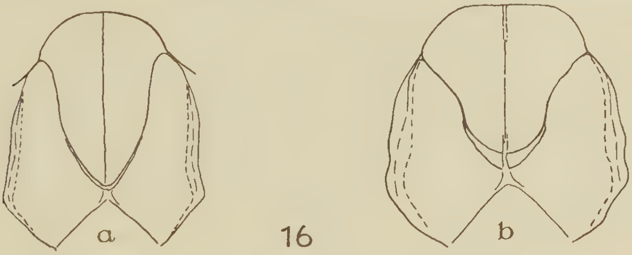
Lygaeonematus coactulus (Ruthe).

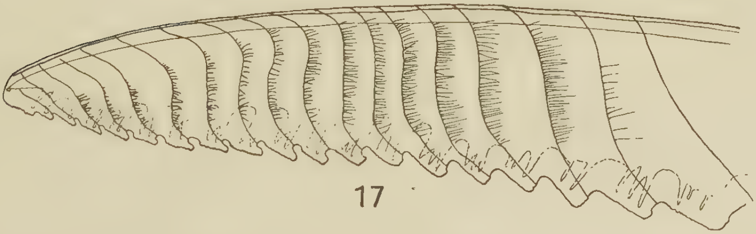
Nematus coactulus Ruthe, 1859, Stettin. ent. Ztg., **20** : 306–307.
N. lativentris C. G. Thomson, 1871, Hym. Scand., **2** : 99.
N. pallipes Cameron *nec* Le Peletier, 1874, Ent. mon. Mag., **10** : 211.
N. whitei Cameron, 1878, Faun. Scotland : 25, 29.
N. scoticus Cameron, 1881, Trans. ent. Soc. Lond., **1881** : 365.
N. breadalbanensis Cameron, 1882, Trans. ent. Soc. Lond., **1882** : 531 nom. n. for *N. pallipes* Cameron *nec* Le Peletier.
N. astutus Cameron, 1885, Mon. Brit. Phyt. Hym., **2** : 77.
? *N. tromsoensis* Kiaer, 1898, Tromsø Mus. Aarsh., **19** : 48.
Lygaeonematus corpulentus Konow, 1904, Z. Hym. Dipt., **4** : 252.
L. boreus Konow, 1904, *ibid.* : 253.
? *L. arcticola* Enslin, 1916, Tenthred. Mitteleurop. (1912–18), **5** : 514–515 (new synonymy).

The very variable species *Lygaeonematus coactulus* (Ruthe) we found commonly in June above 2000 ft., on all the mountains visited in Perthshire, Inverness-shire and Aberdeenshire. Cameron recorded it from Rannoch and

Breadalbane, in Perthshire, Braemar in Aberdeenshire, and from Benmore in Mull. In addition to these records this species has been brought to me from Yorkshire, where it was taken at the top of Moughton, June 1933, by Dr. F. W. Edwards and Mr. W. H. T. Tams, and Mr. H. Britten found it in the Goyt Valley, Cheshire, in April 1926. Probably it occurs on most of the high mountains in Britain. It is certainly the commonest of the high mountain sawflies met with and is so variable that heretofore it has been recorded as consisting of at least four species; possibly still more of the European forms will also later be found to be conspecific with it.

After collecting together three or four hundred specimens I have found every intermediate between the main forms typified by *whitei* Cameron (= *corpulentus* Konow) which is broad, stout and heavily punctured and often with wings in the female approaching to brachyptery, and *boreus* Konow which is slim and smooth; the great variation in the shape of the mesonotum in these two forms is quite remarkable (figs. 16a and b).





FIGS. 16–17.—(16) *Lygaeonematus coactulus* Ruthe, three front lobes of mesonotum of: (a) var. *boreus* Konow; (b) var. *whitei* Cameron. (17) ♀ saw of *Pristiphora asperlatus* sp. n.

The sawsheath from above (fig. 15a) shows very little variation in all the forms of the species; the saw was figured by Cameron 1885, *Mon. Brit. Phyt. Hym.* **2**, pl. xvii, figs. 2–4.

Unfortunately the male genitalia (fig. 15b) and tergum 8 of the male are also almost identical in the males of the closely allied species *Lygaeonematus pallipes* (Fallén), *L. strandi* Konow, and *L. pachyvalvis* Konow. The differences shown in the penis-valves of the male genitalia are so slight that they are of doubtful value until more material is forthcoming.

Lygaeonematus strandi and *L. pachyvalvis* have both been bred from larvae found feeding on birch on Dartmoor by Dr. R. C. L. Perkins, F.R.S. These two species are very close to *L. coactulus*; *L. strandi* can be distinguished through its clearly defined frontal area with a keeled margin together with its entirely yellow sawsheath in the female and hypopygium in the male; *L. pachyvalvis* can be distinguished at once in the female by its very short broad sawsheath, considerably shorter than the cerci when viewed from above and almost as broad as the apex of the hind tibia, but in the male it is not yet possible to distinguish it with certainty from *L. coactulus* on the insufficient material I have examined, unless the slightly broader penis-valves of the genitalia should be found to be reliable characters for separating it, together with *L. strandi.*

On June 17, 1932, I spent twenty minutes watching a female *L. coactulus* var. *boreus* Konow crawling on the top of Meall Ghaordie, Perthshire. It made no attempt to fly, but it attempted to saw a pocket for oviposition in every plant it came upon. I watched it trying mosses, various grasses, sedges and *Salix herbacea* L., but in each of these after sawing for a few seconds it withdrew its saw and moved on. While this was proceeding the cerci were vibrating violently and I imagine have some sensory function in food-plant selection. During the many attempts at oviposition, eggs were successfully laid in leaves of *Gnaphalium supinum* L. three times, once in *Vaccinium uliginosum* L. and once in *Galium saxatile* L. On another occasion I watched a female var. *whitei* Cameron ovipositing in *Galium saxatile* L. From this it seems probable that the species has a number of food plants. The eggs were gathered as soon as laid and brought home, but I was unable to breed them.

Pristiphora asperlatus sp. n.

♂♀ *Colour* black; only the knees of the fore and middle legs, the tibiae of all legs (except the extreme apex and on the hind legs more or less the outer sides which are fuscous), and all the tarsal segments basally are brown. Wings hyaline; stigma, costa and venation pale yellow.

Length 4·5 to 5 mm.; fore-wing 5 mm.; antenna 3 mm.

Puncturation: head slightly rugulous all over; dorsal side covered with warts as is typical in *Pristiphora*; thorax on the mesonotum coriaceous and rugulous; mesopleurae roughly irregularly punctured at least in the middle, but sometimes round the edges and particularly near the junction with the sternum the surface becomes smooth and shining; mesosternum generally unpunctured, smooth and shining, though sometimes becoming rugulous, but always with a smooth area on the ventral line; abdomen coriaceous and shining.

Structure: head very short when viewed from above and roundly emarginate behind; clypeus truncate or slightly roundly emarginate; frontal furrow as a rounded depression or obsolete; frontal area scarcely defined; vertical furrow clearly defined; antennal segment 3 longer than 4, slightly curved; sawsheath in ♀ typical, little wider than the apex of the hind tibia, deeply emarginate behind with long backward projecting curved hairs; ♀ saw fig. 17; ♂ tergum 8 at the apex with two transverse parallel furrows separated by a raised portion between them (fig. 18a); ♂ genitalia in general form as in *Lygaeonematus coactulus* (Ruthe) (fig. 16d), but penis-valve as in figure 18b.

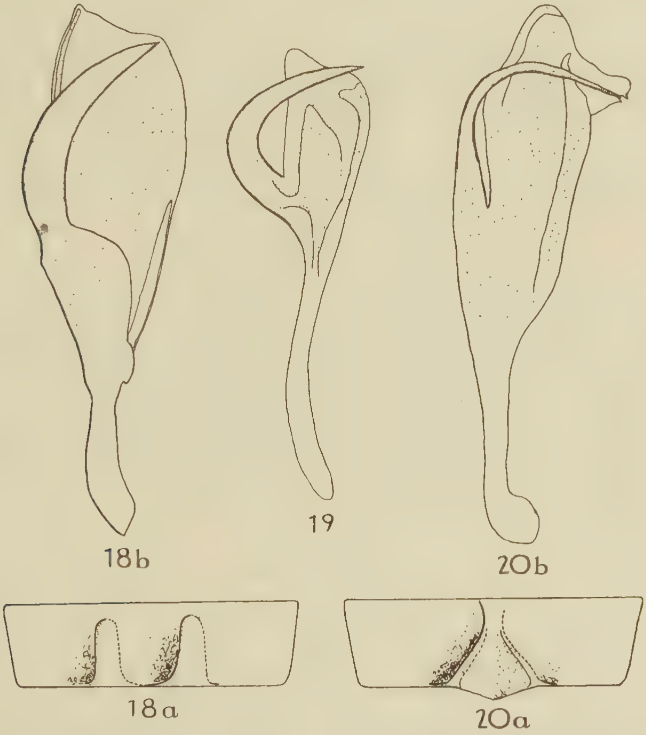
SCOTLAND: Inverness-shire; Mount Braeriach, 4000 ft., 5 ♂♂ (including Allotype), 3 ♀♀ (including Holotype), 25.vi.1934 (*R. B.* and *J. E. Benson*); Cairn Gorm, 4000 ft., 5 ♀♀, 27.vi.1934, 3 ♀♀, 29.vi.1934 (*R. B.* and *J. E. B.*); Cairn Lochain, 3000–4000 ft., 1 ♂, 3.vii.1934 (*R. B.* and *J. E. B.*).

Perthshire: Bein à Chuallaich, 2000–3000 ft., 3 ♂♂, 2 ♀♀ 12-13.vi.1931, 1 ♀, 17.vi.1931; Rannoch 1 ♂, 1–4.vi.1931; Breadalbane Mountains above 2500 ft., 9 ♂♂, 10 ♀♀, 31.v. to 6.vi.1932, and 4 ♀♀, 7–14.vi.1932; near Killin 1 ♂, 31.v. to 14.vi.1932; Benmore, above 2500 ft., 1 ♀, 4.vi.1932; Meall nà Samhne, above 2500 ft., 2 ♂♂, 3 ♀♀, 6.vi.1932, 1 ♀, 19.vi.1932 (all *R. B. Benson*).

SWEDEN: North Lapland: Vassijaure 1 ♂, 4 ♀♀; Kalixfors 1 ♀; Torne Träske, 2 ♂♂, 3 ♀♀ (all *R. Malaise*).

EAST SIBERIA: Kamtchatka Peninsula, 1 ♂, 1 ♀ (*R. Malaise*). Total 26 ♂♂, 38 ♀♀.

This new species belongs to the group to which belong *Pristiphora hyperborea* Malaise and *P. staudingeri* (Ruthe), and would run down to *P. staudingeri* in Enslin's key (1916 *Tenthred. Mitteleurop.* (1912–18), **5**: 518). Unfortunately the colour of the trochanters is not a reliable character for separating *P. melanocarpa* (Hartig) from *P. staudingeri*, as I have specimens of the former, taken in Scotland, with black trochanters but distinguishable from Swedish specimens of *P. staudingeri* by the genitalia.



FIGS. 18–20.—(18) *Pristiphora asperlatus* sp. n.: (a) ♂ tergum 8; (b) ♂ penis-valve. (19) *P. staudingeri* (Ruthe), ♂ penis-valve. (20) *P. melanocarpa* (Hartig): (a) ♂ tergum 8; (b) ♂ penis-valve.

The four palaearctic forms of *Pristiphora* that would run to *P. staudingeri* in Enslin's key can be separated thus:

1. Mesopleurae smooth, shining, and unpunctured . . . . . . 2.
–. Mesopleurae at least strongly punctured in the middle . . . . . 3.
2. Penis-valve of ♂ genitalia (fig. 20b); ♀ saw differs from that of *P. asperlatus* sp. n. (fig. 17), by having no regular rows of backwardly projecting spines to the side ridges, but at most a few very short irregular ones. (♂ tergum

8 with a triangular smooth apical depression, and a raised longitudinal ridge in the middle (fig. 20a). Larva on *Betula*; N. and C. Europe and Siberia) . . . . *melanocarpa* (Hartig).

–. Penis-valve of ♂ genitalia (fig. 19); ♀ saw as in *P. asperlatus* sp. n. (fig. 17a). (♂ tergum 8 much as in *P. melanocarpa* (Hartig), but less deeply impressed. Larva on *Vicia cracca* L., N., and C. Europe, Siberia, but probably confused with the other three species) . . *staudingeri* (Ruthe).

3. Mesosternum smooth and shining, at most vaguely rugulous; ♀ saw (fig. 17); tergum 8 of ♂ with two parallel longitudinal grooves separated by the raised central portion (fig. 18a); penis-valve of ♂ genitalia (fig. 18b) *asperlatus* sp. n.

–. Mesosternum dull, strongly punctured all over; ♀ saw differs from that of *asperlatus* sp. n. (fig. 17), by having no regular rows of backwardly projecting spines to the side ridges, but at the very most a few irregular spines; (♂ not seen) . . . . *hyperborea* Malaise (= ? *pusilla* Malaise).

To this group may also belong the North American arctic species *P. labradoris* (Norton) and the other forms allied to it as described in Marlatt (1896).

Pristiphora quercus (Hartig).

Nematus quercus Hartig, 1837, Adelfl. Deutschl. **1** : 183.
Pristiphora quercus Hartig, Enslin, 1916, Tenthred. Mitteleurop. (1912–18), **5** : 527–528.

This species which feeds on *Vaccinium* is found in many parts of the British Isles and the Palaearctic region but is not abundant. It is not in any way limited to high-mountain regions but is apparently established in various places above 2500 ft. We found that this species liked the flowers of *Alchemilla alpina* L., together with *Pachynematus obductus* (Hartig) and *Pteronidea forsiusi* (Enslin) in the Cairn Gorms in June, but earlier in the year it was to be found in the valleys flying over *Vaccinium.*

BIBLIOGRAPHY.

BENSON, R. B. 1934. "Sawflies from Bear Island." Ann. Mag. nat. Hist. (10) **14** : 207–213, figs. a–c.

CAMERON, P. 1878. "The Fauna of Scotland." Hymenoptera pt. 1.

——. 1882–1892. "Monograph of British Phytophagous Hymenoptera," **1–4** (Ray Society).

ENSLIN, E. 1912–1918. "Die Tenthredinoidea Mitteleuropas," **1–7**, Deuts. ent. Z., Beihefte, **1912–1918**.

KIAER, H. 1902. "Die arktischen Tenthrediniden," *in* Romer and Schaudinn Fauna Arctica, **2** (3) : 401–438.

KONOW, F. W. 1907. "Über die Ausbeute der Russischen Polar Expedition an Blattwespen im arctischen Siberien," Mém. Acad. St. Petersb. (8) **18.** (3).

MALAISE, R. 1920-1921. "Beiträge zur Kenntnis schwedischer Blattwespen," I, Ent. Tidskr., **41** : 97–128, 27 text figs., II, *ibid.* **42** : 1–20, figs. 29–49.

——. 1931. "Entomologische Ergebnisse der Schwedischen Kamtchatka Expedition 1920–1922," 35, Tenthredinidae, Ark. Zool., **23 A** (8) : 1–68.

——. 1931. "Insektfaunnan inom Abisko Nationalpark, Tenthredinidae," Skr. svensk. Vetensk Akad., **17** : 54–68.

MARLATT, C. L. 1896. "Revision of the Nematinae of North America," U.S. Dept. Agric., techn. ser. **3**.

MORICE, F. D. 1896. "Report on Hymenoptera div. Cimbicina, Tenthredinidae" etc., *in* Rev. A. Thornley "On some Hymenoptera and Hemiptera from the Summit of Ben Nevis collected by W. S. Bruce," Ann. Scot. nat. Hist., **1896** : 166-167.

MORICE, F. D. 1898. " Further Notes on sawflies (Tenthredinidae) from the summit of Ben Nevis, including a species new to Britain," *ibid.* **1898** : 80.

RUTHE, J. F. 1859. " Verzeichniss der von Dr. Staudinger im Jahre 1856 auf Island gesammelten Hymenopteren," Stettin ent. Ztg., **20** : 305–309.

SALISBURY, E. J. 1932. " The East Anglian Flora," Trans. Norf. Norw. Nat. Soc., **13** : 207–213.

SCHARFF, R. E. 1907. European Animals.

TANSLEY, A. G. 1911. Types of British Vegetation : 288–329.

TRAIL, J. W. H. 1888. " The gall-making Hymenoptera of Scotland exclusive of those that live on oak," Trans. Perthsh. Soc. nat. Sci., **1** : 72–90.

——. 1888–1889. " Galls of Norway," I, Trans. bot. Soc. Edinb., **16** : 212–213. II, *ibid.* **17** : 485–486.

THOMSON, C. G. 1871. " Hymenoptera scandinaviae," **2**.

WILMOTT, A. J. 1930. " Concerning the history of the British Flora " *in* Contribution à l'étude du Peuplement des Isles Britanniques, Soc. Biogéogr., **3** : 163–191.

THE EARLY STAGES OF *MINOA MURINATA* SCOP. (LEP., GEOMETRIDAE) WITH A DESCRIPTION OF THE VERRUCAE OF THE LARVA

By E. A. Cockayne, D.M., F.R.C.P.

[Read 7th November, 1934.]

With Plates III and IV.

In 1933 I bred *Minoa murinata* from the egg and saw larvae for the first time, but being busy I did not examine them very closely while they were small. When they were in their last two instars I noticed their remarkably hairy appearance, and found that it was due to the presence of numerous secondary setae arising from plates of thickened cuticle forming true verrucae. Remembering that Fracker says that no Geometrid larva has verrucae, I wrote to Mr. L. B. Prout and received the following reply to my questions: "Your notes on *Minoa* larva are most interesting and quite new to me. I have looked at my bibliographical notes and cannot find any reference to any really thorough account of the biology of the species. I think we may assume therefore that your discovery is unrecorded. I don't consider that there are any other known species of *Minoa*. There is none in America. Dr. Turner acting on my suggestion, which I offered in Seitz, that a venational difference might be of service in escaping Meyrick's unwelcome 'telescoping' in *Asthenas*, transferred one of his Australian *Asthena* (*A. euthecta* Turner, 1904, *Proc. Roy. Soc. Vict.*, **16** : 243 = *Minoa euthecta* Turn., 1923, *Trans. Roy. Soc. S. Austral.*, **46** : 233), but as it has nothing of the habitus of our Palaearctic species and on zoogeographical grounds a real relationship would be almost unthinkable, I have ventured to ignore the transference." This made it necessary to examine the first two instars more carefully, and so I obtained eggs again this year, 1934, and once more bred it to the pupal stage.

Though it is usually regarded as a day-flying moth I found that the eggs are laid at night, singly, in pairs, or in rows, up to the number of twenty in a row, on the wood spurge, as a rule on the floral leaves. They are flattened and oblong, ·55 mm. long × ·40 mm. wide, slightly broader at one end, devoid of sculpturing, and greenish-white in colour. They remain seven to nine days in the egg stage, and a day or two before hatching the head of the larva becomes visible as a blackish spot at one end, but no other colour change takes place.

The Larva. First Instar.

Length newly hatched ·75 mm., ready for ecdysis 1·75 mm. The head is dark brown with lighter labrum and mouth-parts. The ground-colour is white and the long white setae, as long as the newly hatched larva is wide, arise from large plates or pinacula, which, white at first, soon turn dark grey. The light brown prothoracic plate is rather narrow and excavated posteriorly on either side between the beta and delta setae and in the midline between the two beta setae. There are the usual six setae on each side, alpha, gamma. and epsilon forming the anterior row and beta, delta, and rho forming the posterior row. Laterad of the plate is the single prespiracular seta, kappa, and above the leg are two setae on one pinaculum, nu and pi. On the meso- and metathorax alpha and beta are single and each has its own pinaculum, epsilon and rho arise from one large pinaculum, while kappa and pi are both single and nu is absent. On the first, second, and third abdominal somites alpha and beta, the anterior and posterior trapezoidals, rho, the supraspiracular, kappa, the postspiracular, and eta, the subspiracular are all single setae, each on its own pinaculum, nu and pi are on separate pinacula, nu being very small and on a minute pinaculum. The sixth abdominal is the same except that nu and pi are on a very large irregular pinaculum almost separated into two parts, situated rather low down on the external aspect of the proleg. On the seventh abdominal alpha, beta, rho, kappa, eta, nu, and pi all have their own pinacula, but that of nu is very small. On the eighth abdominal kappa and eta are on the same pinaculum, and nu is absent. On the ninth there are five single setae each on its own pinaculum. On the tenth there are the usual four setae on each side of the anal plate; on the antero-external aspect of the proleg is a small pinaculum with two setae and on the postero-external aspect a larger one with four setae, and on the anal lobe a single large seta, theta. On each side of the venter of all the first nine abdominal somites is sigma, a very small seta with no pinaculum. The crochets are black and uniordinal. Growth in this instar is very great and the pinacula become widely separated as shown in my figure of a larva preparing for ecdysis.

SECOND INSTAR.

Length 2·5 mm. At this stage a number of additional setae make their appearance on many pinacula. The prothoracic plate has a variable number of subsidiary setae. A small one may lie internal to alpha, and another between alpha and gamma, one may be present in connection with beta, one or two in connection with delta, and one in relation to epsilon and rho, which lie on a distinct semilunar portion of the plate. The total number of primary and subsidiary setae on each side of the plate is nine to twelve. Kappa, the prespiracular, is now a group of three setae on one pinaculum, and the pi group consists of four setae on an oblong pinaculum. The meso- and metathorax are much alike. Alpha is still a single seta, but beta is a group of three or four on one pinaculum, epsilon and rho remain as single setae on a common pinaculum, kappa is a group of three or four, eta a single seta and the pi group four or five on one pinaculum. The first three abdominal somites resemble one another, though the number of secondary setae on a given pinaculum may differ on different somites or even on the two sides of the same one. The usual numbers are as follows—alpha five, beta six, rho four, kappa four, eta three, nu three, pi two, and lying ventrad is sigma with two setae. On the fourth abdominal rho has five setae, kappa four, and eta two, and below these are two pinacula, lambda and mu, each with two setae, ventrad of which are two single setae, nu and pi, in the same longitudinal line and still further ventrad is the single seta sigma. In other respects this somite is the same as the preceding. The arrangement of the fifth abdominal is very similar; alpha has six setae, beta six, rho three to five, kappa six, eta two, lambda two, and mu two to four. On the sixth abdominal alpha has four setae, beta five, rho three, kappa five, eta two, and below is a pinaculum with four setae, and at the base of the proleg are two pinacula, the anterior with three and the posterior with one seta, and nearer the distal end of the proleg is a large plate with eight setae. On the seventh abdominal the pinaculum of alpha has only one seta, beta has four, rho one to five, kappa one to two, eta one, and ventrad is the pi group with three or four setae on one pinaculum and sigma with one. On the eighth alpha has one seta, beta four, rho two, kappa and eta are on one pinaculum, which may have an additional seta on it, and ventrad lies a single seta. On the ninth abdominal the pinacula lie in a line round the somite, alpha and beta each one seta, rho three, kappa one, eta two, and pi one. On the tenth abdominal many secondary setae are present on the anal plate, eleven setae being the number on each side, and the anterior plate of the proleg carries two setae, while the posterior plate carries eleven in two groups, four in the anterior and seven in the posterior. There is also a seta on the anal lobe and one on the lobe below the anus, on each side. The ground-colour in this instar is still white but there are faint indications of the pattern, which appears clearly in the next; the pinacula are but little darker than the surrounding cuticle and the conical tubercles, from which the setae arise, leave much of their surface visible.

THIRD INSTAR.

Length 4·5 mm. Secondary setae are still more numerous and their tubercles occupy a larger part of each pinaculum. On the prothoracic plate there are on each side thirteen to fourteen setae, and there is a depression between each of the groups consisting of a primary seta and its satellites. The alpha group consists of two, the gamma two, the beta two or three, the delta two or three, and on the semilunar part with epsilon and rho there are three to six setae in all. The prespiracular kappa group consists of three setae on one pinaculum and pi of seven. On the mesothorax the pinacula bear the following numbers of setae respectively, alpha five, beta nine, epsilon and rho four on their common pinaculum, kappa five; eta is a single thick curved seta, and the pi group consists of seven setae on one pinaculum. On the metathorax there is the same arrangement, but alpha has seven and epsilon and rho together have six setae, while a single seta is present anterior to the pi group of seven.

Abdominal somites one to four inclusive have on the alpha pinaculum nine setae, on the beta twelve, on rho seven, eight, or nine, on kappa seven, on eta six or seven. Ventrad of these are two pinacula, lambda and mu, with seven and four setae respectively on the first abdominal, six and five on the second, and five setae on each on the third and fourth. On the first three abdominals a single pinaculum, nu and pi, bearing six setae lies still further ventrad, while on the fourth abdominal there are two pinacula with three and five respectively, and on the fifth with two and four. On the sixth abdominal the following are the setal numbers, alpha six or seven, beta nine, rho seven, kappa seven, eta seven, below eta a group of seven on one pinaculum, and on the external aspect of the proleg a group of six to eight, and distad of these a plate with thirteen to nineteen. On the seventh abdominal the numbers are, alpha four, beta five, rho four, kappa four, eta three, and below eta a group of nine setae. On the eighth abdominal the numbers are, alpha two or three, beta four or five, rho six, kappa one, eta two, and below eta a single seta. On the ninth abdominal the pinacula are in line and from the dorsum downwards have the following setal numbers, four, one, two, one, and according to Fracker they belong respectively to beta, alpha, rho, and eta. On the tenth abdominal the anal plate has eleven setae on each side; there is the large seta, theta, on the anal lobe and another seta on the lobe below the anus; on the external aspect of the proleg there is an anterior plate with two setae and a posterior plate with fourteen disposed in three groups, a lower group with five and two upper groups, the anterior with five and the posterior with four.

The head is light brown with a very broad dark brown stripe running vertically down the middle of each lobe and a dark brown clypeus or front (Fracker); ocelli black; prothoracic plate tinged with pale ochreous; legs light brown. The ground-colour, pinacula, and setae are white. A broad grey stripe runs along the dorsum of the thorax and anterior half of the first abdominal somite, its outer edge lying midway between the alpha and beta pinacula. On the dorsum of the first to the fourth abdominals inclusive a grey line runs from just inside each beta pinaculum to the alpha pinaculum of the next somite and thence runs outwards to join a black spot lying between the alpha and rho pinacula; this grey line is continued obliquely downwards and backwards to join the narrow blackish spiracular line. A broad grey dorsal stripe runs along the last five or six abdominal somites becoming narrower and blacker towards the anal end of the larva. There is a faint grey mark round each pi group forming an indistinct subspiracular stripe, which becomes darker and better defined on the last five abdominal somites, and a black line runs vertically down the external aspect of the anal proleg. The space between the spiracular and subspiracular lines is filled in with clear pale yellow.

FOURTH AND FINAL INSTAR.

Length 9 mm., breadth at the mid-abdomen ·8 mm. when full grown. The pinacula are now so crowded with setiferous tubercles that they are best described as verrucae. The larger and more circular verrucae seen from above consist of a large central conical tubercle with a long seta pointing vertically upwards and round this is a ring of shorter and thinner setae set obliquely and pointing away from the centre. The arrangement is, however, less regular in some verrucae, both large and small, and no single seta is larger than the rest. In some, including most of the dorsal ones, the cones are pale like the ground-colour, in others their apices are black, and on the darkest parts of the body the conical tubercles, those of pi for example, are wholly dark. The tubercles of each verruca arise from a polished cuticular plate, the pinaculum, which on the lightest parts of the body is pale grey and on the darker parts blackish.

Thorax. The prothoracic plate is crowded with setae, each on a conical elevation; sixteen are present on each side arranged in the following groups, alpha two, gamma three, beta two, delta three, epsilon and rho six, but the number in each group is inconstant. On the prothorax the kappa verruca has three setae and the nu and pi group have a common verruca with seven. The mesothorax has verrucae with the following setal numbers—alpha four to five, beta nine to ten, epsilon and rho together eight, kappa six, eta one thick and curved, nu and pi together nine. The metathorax is similar, but the alpha verruca has nine setae.

Abdomen. On the first abdominal the setal numbers are—alpha nine to ten, beta twelve, rho eight or nine, kappa six to seven, eta seven (in one case five with a single separate seta above), lambda seven, and mu six. On the second abdominal the numbers are—alpha nine to ten, beta twelve, rho eight to nine, kappa seven to eight, eta six to seven, lambda six, and mu seven; on the third abdominal alpha nine to ten, beta twelve, rho nine, kappa eight, eta five, nu five, and pi five; on the fourth abdominal alpha nine to ten, beta twelve, rho nine to ten, kappa eight to nine, eta five to seven, lambda six, and mu eight. On the fifth abdominal the numbers are alpha eleven, beta twelve to thirteen, rho ten, kappa eight, eta six to seven, and below eta two verrucae, the anterior with six and the posterior with ten setae (in one case nine and a separate seta). On the sixth abdominal the numbers are alpha nine, beta eight, rho seven to eight, kappa seven to eight, eta six to eight, and below eta a verruca with eight setae; on the external aspect of the proleg there are eleven setae, which do not arise from a definite plate. On the seventh abdominal the verrucae bear the following numbers of setae—alpha six, beta six, rho three to four, kappa four to five, eta two to four, and below is a verruca with ten. On the eighth abdominal the numbers are alpha three (in two cases there was asymmetry, two on one side and four on the other, and two on one side and three on the other), beta seven, rho two to three, kappa and eta together on one verruca three, and below a single seta or a verruca with three or four. On the ninth abdominal there are four lateral verrucae with five, two, five, and three to five setae respectively, the most dorsad, according to Fracker, being beta. On the tenth abdominal somite there are five single setae on each side of the anal plate and an oval verruca bearing ten setiferous tubercles, while on the external aspect of the proleg there is a verruca with five setiferous tubercles and below it five single setae on the anterior portion, and on the posterior portion there are eleven setae in two groups, an upper one with five and a lower one with six setae. The anal lobe of each side has a single large seta, and there is a smaller one on the lobe below the anus.

On the ventral aspect of the larva there are only two verrucae on each side of the first three abdominal somites. The most ventrad, sigma, is variable and the number of setae it bears may differ on the two sides. The number of setiferous tubercles on the less ventrad, the combined tau and pi verruca, and the more ventrad, the sigma verruca, on these three somites is seven and two, seven and two or three, and six and two or three respectively. The fourth abdominal is very variable and in some cases its setal arrangement is like that of the third, in others like that of the fifth, or it may resemble the third on one side and the fifth on the other. Of the ten larvae examined all have the most ventrad verruca, sigma, with two setae. Six have tau and pi well separated from one another, as in my figure, tau with two or occasionally three setae and pi with two to five. One larva has these verrucae close together on the left and far apart on the right side, another has them united on the left with six setiferous tubercles and far apart on the right side, while yet another larva has a combined verruca with seven setae on the right and two separate ones with one and three setae respectively on the left side.

One larva has a combined tau and pi verruca with five setae on the one side and two verrucae with separate but contiguous pinacula on the other side, the tau verruca with two and the pi with four setae. On the fifth abdominal the tau verruca has two to three, the pi five, and the sigma two setae; on the sixth abdominal tau and sigma are on the internal aspect of the proleg, and I was unable to count the setae with certainty; on the seventh abdominal tau, pi, and sigma are represented by single setae; on the venter of both the eighth and ninth abdominals are two single setae presumably pi and sigma. The crochets on both pairs of prolegs are light brown and of various sizes, though not regularly biordinal. All the spiracles are black and nearly circular. The head in this as in the preceding instars has the same number of setae as the various species of the genus *Asthena* sensu lato.

The drawings of larvae in the first two instars were made from living and spirit specimens, but those in the final instar are from a blown larva, and, although they give an accurate picture of the area occupied by the verrucae relative to the total area of the skin, in the living larva the folds and wrinkles make the verrucae appear to occupy a much greater proportion of the surface.

THE COLOUR AND PATTERN IN THE LAST INSTAR.

The head is dark brown with a light brown area round the ocelli and light brown adfrontal pieces and labrum. The prothoracic plate is black divided medially by a slender whitish line. The ground-colour is Congo pink or less often pale Congo pink (Ridgway), and the black markings are so extensive that the larva looks more like a black one with pale markings than a pale one with black markings, though all the surface that is white in the penultimate instar still shows a pink tinge in the paler larvae. The only remaining ground-colour on the dorsum is a broken stripe on each side of the thorax in the line of the beta verrucae and on each of the first four abdominal somites a roughly triangular mark with the apex between the two alpha verrucae and the base extending to and including the two beta verrucae, the alpha verrucae being black or pink with black apices to the conical tubercles; in the darkest larvae each triangular area is reduced to a dorsal longitudinal line and a transverse line joining the two beta verrucae; from each triangular patch a line of pale ground-colour hooks over a black spot just external to each beta verruca and runs back as far as the rho verruca of the following somite. On the fifth abdominal the triangle is encroached upon by black extending behind each alpha verruca, while the ground-colour in front of the beta verrucae extends further forwards.

On the sixth, seventh, eighth, and ninth abdominal somites the whole area between the alpha verrucae is black, and on the tenth there is a black dorsal mark shaped like a shallow wine-glass with a thick stem. On the lateral aspect the whole of the prothorax posterior to the prespiracular verruca between the external margin of the plate above and the pi verruca below is pink, though in dark larvae it is much suffused with black. On the rest of the larva the spiracular stripe is black but for a ring of pink round each spiracle, and the broad subspiracular stripe is pink broken by black between the eta and kappa verrucae. In the palest larvae there is also a patch of pink in front of each mu verruca.

There is a broad ventral pink stripe running the whole length of the larva. On the external aspect of the swellings from which the legs arise and close to their origin is a transverse band of pink and a similar band crosses the external aspect of the ventral prolegs. The legs are light brown and the spiracles black and nearly circular.

In all instars the larva is very short and stout and sits with its body arched. It drops readily when alarmed and often hangs by a silk thread. Though its natural food is the wood spurge, *Euphorbia amygdaloides*, of which it prefers the flowers and floral leaves to the larger leaves, it will eat many other spurges in captivity and thrives on the petty spurge, *E. peplus*, and on the dwarf spurge, *E. exigua*. Growth is rapid, the period from the day of hatching to that of entering the earth for pupation being on an average twenty-eight days, eleven of which are spent in the last instar. Mr. C. N. Hawkins, who examined the pupae, told me that the pupal setae are in no way peculiar.

In 1933 one imago emerged in August and in 1934 the six larvae, which I allowed to pupate, all produced imagines in September, the second brood being doubtless due to the exceptionally hot weather in the summer of both these years.

I have examined larvae, in the final instar, of all the British species of *Asthena* sensu lato, *Asthena albulata* Hufn. (*candidata* Schiff.), *Discoloxia blomeri* Curt., *Euchoeca nebulata* Scop. (*obliterata* Hufn., *heparata* Schiff.), *Hydrelia testaceata* Don., *H. flammeolaria* Hufn. (*luteata* Schiff.), as well as that of *Venusia cambrica* Curt., and find that all of them have single tubercles each surmounted by one seta. The presence of verrucae in *murinata* and their absence in these other genera seems to me an additional reason and a strong one for keeping *murinata* in the separate genus *Minoa*, though insufficient to entitle it to higher rank.

Verrucae appear to have originated independently many times in the larvae of the Lepidoptera as is shown by their occurrence in widely separated families and even in different superfamilies. Amongst others they are present in the PTEROPHORIDAE, ZYGAENIDAE, MEGALOPYGIDAE, NOLIDAE, ARCTIIDAE, LITHOSIIDAE, SYNTOMIDAE, PERICOPIDAE, LIPARIDAE, and NOCTUIDAE in the genera *Acronicta* and *Demas*. The fact that they are also present in a Geometrid larva is therefore not in itself surprising, but it will be very remarkable, if the genus *Minoa*, with but a single species, ultimately proves to be the only Geometrid, in which they have been evolved.

Explanation of Plates III and IV.

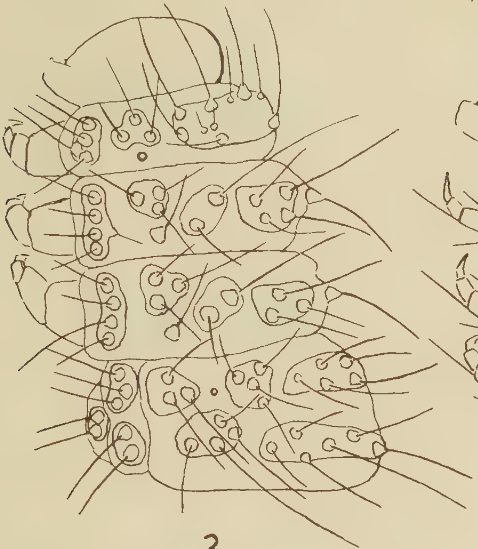
Plate III.

Fig. 1. Head, thorax, and first abdominal somite of larva of *Minoa murinata* in the first instar preparing for ecdysis.
2. The last six abdominal somites of the same larva.
3. Head, thorax, and first abdominal somite of a larva in the second instar.
4. The last six abdominal somites of the same larva.

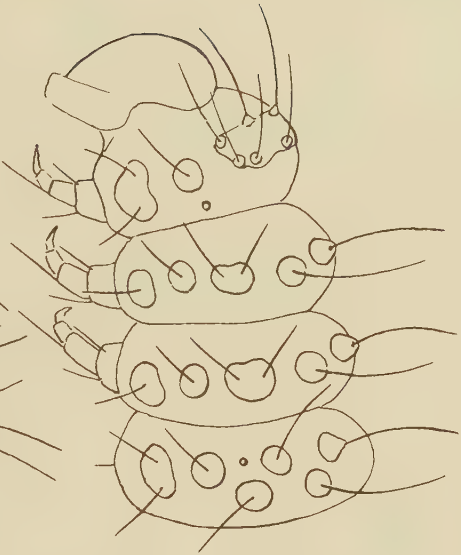
Plate IV.

Larva of *Minoa murinata* in fourth instar, full-grown.

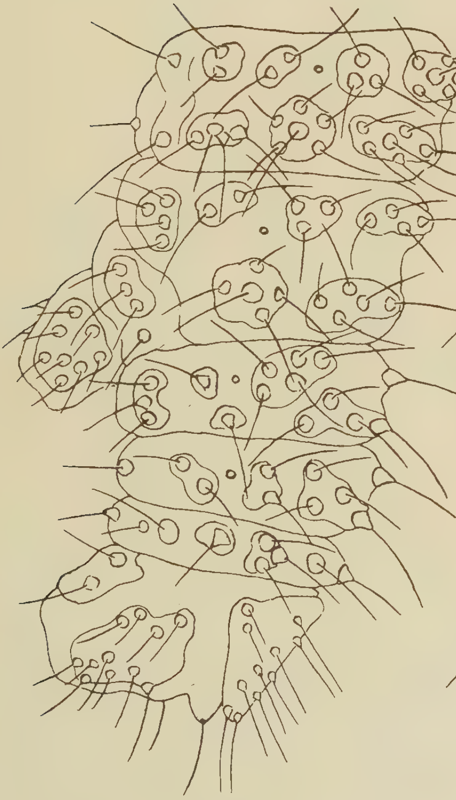
Fig. 1. Dorsal view of prothorax, showing prothoracic plate, and of mesothorax, showing alpha and beta verrucae.
2. Lateral view of prothorax, omitting all prothoracic setae except epsilon and rho groups, and of mesothorax with alpha and beta verrucae omitted.
3. Dorsal view of fifth abdominal somite showing alpha, beta, and rho verrucae.
4. Lateral view of third abdominal somite.
5. Dorsal view of last three abdominal somites.
6. Lateral view of last five abdominal somites.
7. Ventral view of fourth abdominal somite.



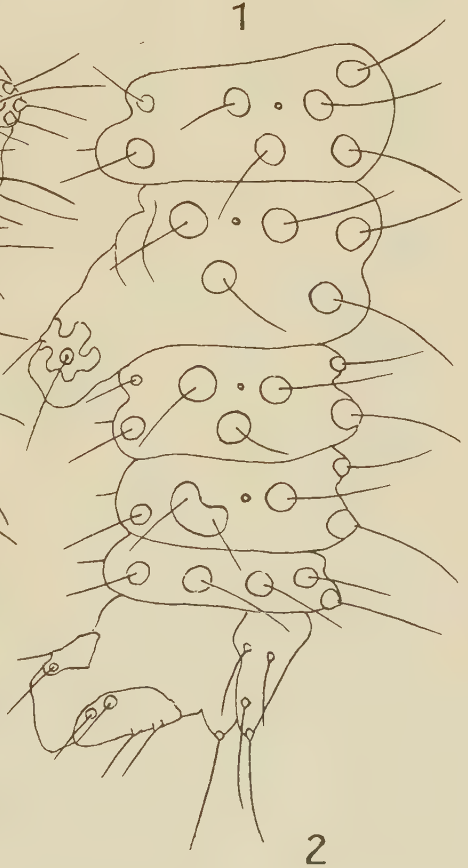
3



1

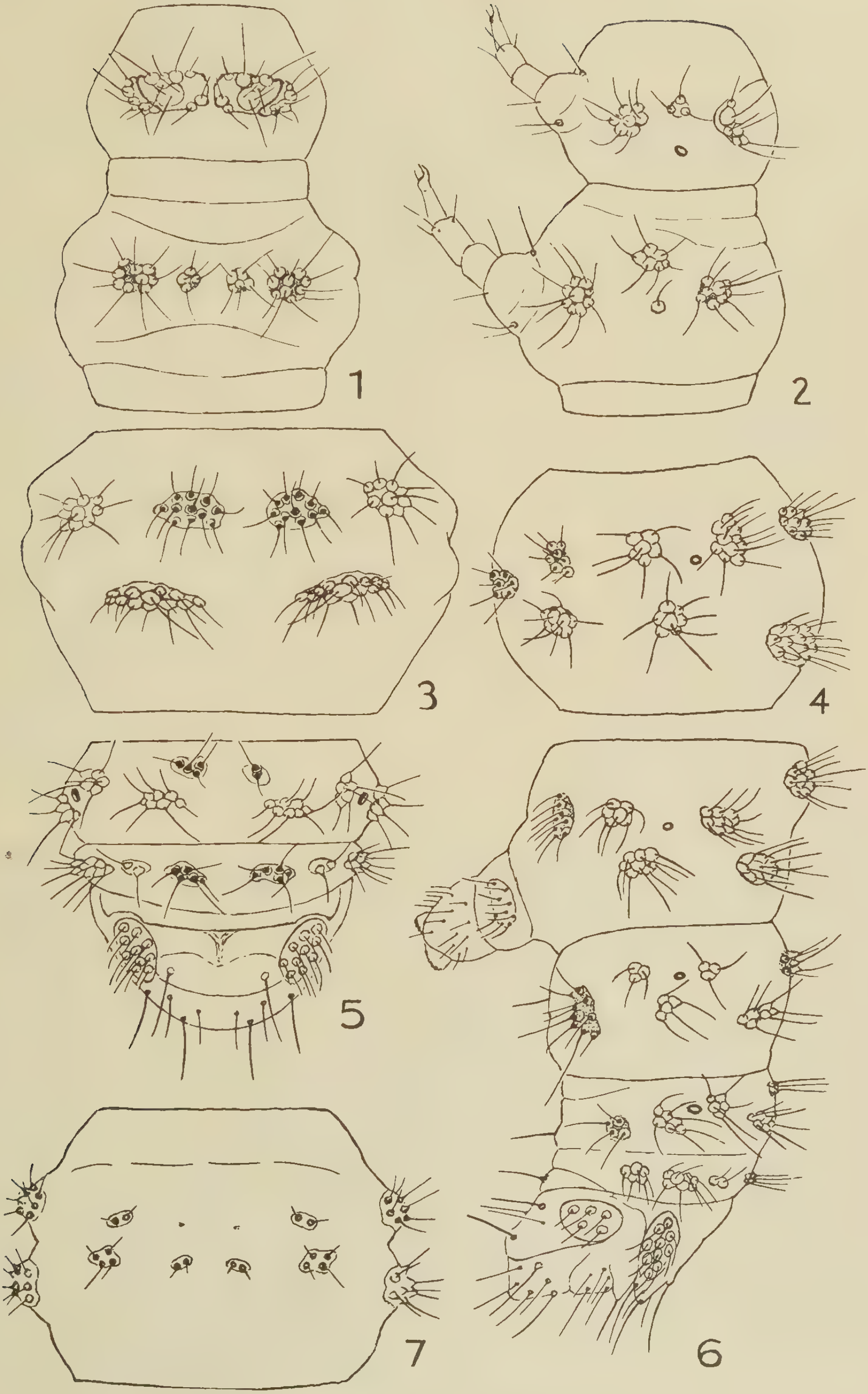


4



2

The early stages of *Minoa murinata* Scop.



The early stages of *Minoa murinata* Scop.

THE LOCATION OF OLFACTORY RECEPTORS IN INSECTS: A REVIEW OF EXPERIMENTAL EVIDENCE

By Joseph Marshall.

(*Entomology Department, Rothamsted Experimental Station.*)

[Read 6th March, 1935.]

Contents.

	PAGE
Introduction	49
Early Views	50
Sex Response	51
Early Experiments	52
Experiments of Fielde and Barrows	54
Experiments of McIndoo	55
Experiments of von Frisch	57
Experiments of Minnich	58
Recent Experiments	59
Associate Factors	61
Present Position of the Subject	63
Summary	65
Acknowledgements	66
References	66
Addenda	71

General Introduction.

The olfactory sense in insects has been used by many workers as a basis for experiment. General considerations of this sense show that, although the literature itself is voluminous, there is very little unification, and the entire subject, because of the many conflicting points, has been left in a somewhat vague state.

In the vertebrates the chemical senses may be classified (Parker 1922) into three main headings—smell, taste and the general chemical sense, all of which can be subdivided into many more divisions. These three divisions in the vertebrates are distinct so that what is perceived by one of these senses will not stimulate the other two. Parker and Stabler (1913) show that in these animals the chemical sense has a threshold value two or three times higher than that of taste, which is 24,000 times as strong as the threshold value for smell. No work of a similar nature has been done with insects, although the three main divisions of the vertebrate chemical senses are taken to apply. Against this assumption McIndoo (1914–1933) is inclined to the view that there is no real division between these three senses in the insects, and regards taste as being a less sensitive form of smell. In the vertebrates the three senses are all stimulated by means of a chemically active substance in solution coming into direct physical contact with an exposed sensory cell (Parker, 1922).

Experimenting with 47 ethereal oils von Frisch (1919) demonstrated that bees, trained to any one particular oil odour, for instance essence of orange, could select this odour again with considerable accuracy. Four of these oils were found to be confused to some extent with essence of orange, and all these oils had in common their mode of preparation from citrus fruits and had oils of lemon and linalol in their chemical make-up. In man also the apparent sameness of smell of these oils causes confusion. Von Frisch remarked that man and the honey-bee are very similar in their olfactory threshold values in spite of their having different organs of sense.

The olfactory sense in insects is defined by Forel (1908) as a " special sense which allows the animal to recognise at a distance, by some specialised energy, the [chemical] nature of a certain body " ; and he adds that certain substances can irritate nerve endings, other than those of olfaction, giving an instance of benzene which causes intense irritation on the conjunctiva when brought near to the eye. Insects are able, by means of this olfactory ability, to detect objects and their location at distances with constant accuracy. The relation and possible overlapping of the olfactory sense with that of taste and perhaps the general chemical sense is a very controversial matter and its consideration will be left until the literature has been reviewed.

It is well known that insects possess powers of olfactory perception. Critical understanding of the location and nature of the organs concerned is a matter which has caused considerable confusion and misinterpretation. Authors often err on the side of assuming explanations based on the analogies in man, or attribute to insects used in the experiments abilities which they never possessed. A review of such literature because of this heterogeneity must be divided under headings.

Early Views.

The existence of such a fertile field for research attracted considerable attention from the start. Owing to the complete lack of any previous work the subject stimulated the imagination of all workers, and nearly all parts of the insect's body were in turn suggested as a possible centre of the olfactory organs.

Baster (1798), Burmeister (1836), Cuvier (1799–1805), Dumeril (1823), and Lehmann (1799), propounded the theory that the olfactory organs were located in the stigmata or the tracheae, Lehmann comparing the spiracles of the insects with the nose of the vertebrate. More recently Joseph (1877) claimed to have demonstrated that there was an olfactory region near the spiracles, but Forel (1908) regarded this conclusion as inaccurate being based on inadequate preparations. Burmeister, also, considered that insects smell with what he describes as an " internal superior surface." The salivary glands in the head were mistaken by Randohr (1811) for the olfactory apparatus. Rosenthal (1811) located the seat of olfaction in the folds of chitin between the two antennae, whereas the buccal cavity or mouth of the honey-bee was suggested by Huber (1814) to serve for olfaction. Treviranus (1816) placed the olfactory centre in the oesophagus, and Kirby and Spence (1826) believed that the terminal nervous system of the palate, the so-called rhinarium or nostril piece, was the seat of olfactory perception. Paasch (1873) claimed that a plate between the eyes and the antennae functioned in this way.

Reverting to the old idea of internal olfactory organs Wolff (1875) assigned this ability to the hair-like organs on the epipharynx, and in this contention he is supported by Graber (1885–1887). These organs are described by Meinert (1860) in connection with the mandibular glands on the sides of the head.

Wolff, in ascribing a function to these mandibular glands, called them " olfactory mucous glands" and suggested that they secreted a fluid which moistened the olfactory organ on the epipharynx, even postulating that this fluid might have remarkable chemical properties and would exert an effect on the extent of olfactory response. Meinert's exposition on the real nature of these glands disposes of any theories based on Wolff's interpretations. As a basis for classification Wolff used the development of the hair-like organ on the epipharynx, and graded the following in order of olfactory ability—Queen-bee, worker-bee, and a series of Hymenopterous insects grading down to the Braconids. In these last insects, since this organ was only represented by rudimentary nerve endings, he concluded that olfactory perception was extremely small. This conclusion is the reverse of what is known to be true, since by their very method of oviposition the Braconids must have a well-developed olfactory sense. Also bees are not believed to be insects possessing a highly specialised sense of smell as Wolff's hypothesis would suggest. Unfortunately all the theories advocated by Wolff must be ignored in spite of his good experimental work. Meinert's exposition on the real nature of the glands, believed by Wolff to be connected with olfactory response, was corroborated by Schiemerz (1883), and this, with the incorrectness of the deductions made as to the olfactory powers of the different insects, disposes of any value that they may have.

The palpi were suggested as the centre for the olfactory organs by several workers—Bonsdorf (1872), Cornalia (1856), Knoch (1801), and Marcel de Serres (1800)—whereas Perris (1850), assigned only a small olfactory power to the palpi.

There can be no doubt that in early experiments the results were very confused, and the part of the body considered to be the centre for the olfactory processes depended largely on the bias of the worker. Comparetti (1800) located the olfactory organs on various parts of the insect's body in different families; he placed them on the frontal glands on the forehead in the Orthoptera, on the proboscis in the Lepidoptera, and on the antennae in the Lamellicornia.

Whilst these conflicting opinions on the situation of the olfactory organs were being expressed, the main body of workers was gradually accumulating evidence either for or against the part played by the antennae as the centre of smell. The very position of the antennae suggests that they would serve as an excellent centre for olfactory perception. There have been several kinds of experimental methods adopted for the purpose of demonstrating the part played by the antennae in the insect's response to smell and for the sake of clarity the experiments are dealt with in groups.

Sex Response.

The ability of male insects to recognise the female of its species has always been a much-discussed phenomenon. In *Philosomia cynthia* Riley (1894–1895) reported an instance where a male located a female of the same species one and a half miles away, and Fabre (1879–1904) described a remarkable case where a single female of *Bombyx quercus* attracted sixty males in a locality where the species had been a rarity and had not been seen for twenty years. Such instances, and numerous others not quoted here, show the sensitiveness of the insect's recognition of the female sex. The means of attraction between the male and the female in such cases is believed to be due to smell, although the possibility that it may not be so suggests itself. On this point Minnich (1929) said that the question of " non material forms of emanation," such as waves, has been suggested but " the ability of such waves to pass through simple air-tight containers, in which the females are enclosed, indicates that we are dealing with a chemical stimulus." This statement is not clear but, from the context, it must mean that insects in air-tight containers fail to attract, and so the attraction cannot be due to a " non material " form of attraction, since the glass container would, according to Minnich, not act as a barrier to such a force.

In spite of Minnich's conclusion the observations of Elliston Wright (1929) carry much conviction. He remarked that most observers totally failed to realise that there are two forces involved in the attraction of the male. " Attraction in the near or immediate neighbourhood of the female operates almost certainly through a sense of smell; whilst attraction from a distance, probably the more important is almost as certainly due to some sense other than that of smell." Several observations demonstrated that a male, attracted by a distant female, came towards her in a straight line. When in proximity to her the male appeared to lose this sense of direction and after many failures located the female by what was presumed to be smell. Whenever males were being attracted the females were " calling " which is described as " continuous rapid fine vibratory movements of wings with extrusion and extension of terminal parts of abdomen " and that as soon as they ceased to " call " the males were no longer attracted. The author remarked that the failure of the female of *S. carpini* to attract males when wrapt up in brown paper (Poulton, 1928) is understandable, since this sun-loving female would not " call " when in darkness. Minnich's experiments might be explained on the same grounds. There is no doubt that at short range smell enters into the recognition of the female by the male. Thus if olfactory experiments are conducted using this sex attraction only at close range it can be assumed that olfactory stimulus is the cause of the attraction. There is, of course, the danger that this " calling " ability might complicate the olfactory reactions even at such close ranges. Fabre showed that the presence of strongly smelling substances near the females did not interfere with the attractive power of the female. This work of Fabre's certainly would fit in very well with the observations of Elliston Wright.

Mayer and Soule (1906) brought forward some extremely interesting observations where sex attraction was used as the olfactory stimulus. Results of work on the mating instincts of certain Lepidoptera showed that a male readily copulated with the female; after a male had been seen to do this its antennae were covered with paste, when it no longer evinced any copulatory desire or excitement even when the female was in very close proximity. On the paste being removed it once more behaved normally and mated. A further experiment was described where air blown over a female Saturnid on to a male of the same species resulted in the male mating with a Saturnid of a different species which was in the same cage, although hitherto the male had completely ignored it. This experiment shows that here the sex stimulus was of an olfactory nature, since until air was passed over the two Saturnids of the same species no mating instinct was observed.

Early Experiments.

(a) *Supporting the view that the antennae are the centre of olfaction.*

Working on bees and wasps Lefebvre (1838) performed many experiments obtaining results in support of the theory that the antennae serve as the centre of olfactory processes in insects. In particular it was described how a needle, wetted with ether, was brought, from behind, close to a bee eating sugar. No notice was taken until the needle was near to the head and then it was the antennae which moved towards the needle. When a needle, wetted with ether, was brought near, or even touched, the abdomen, stigmata or wings, there was no reaction so long as care was taken to avoid the eyes or the antennae. Wasps, the antennae of which had been removed, appeared indifferent to ether. This experiment of Lefebvre's is in accordance with what is now accepted; namely that the antenna, by their actions in closely following any needle on which is some odorous substance, show a marked apparent connection with the olfactory reception. Evidence of this kind strongly supports this antennal olfactory theory.

Using moths, of which the antennae had been amputated, Dugés (1838) gave data which showed that these could no longer find females, and similarly blowflies could no longer find putrid meat when they had their antennae removed. Confirming Dugés, Balbiana (1866) gave further instances where male butterflies, after antennal amputation, failed to locate females. In his memoir Perris (1850) came to several conclusions from experiments where the antennae were amputated to varying degrees—on amputating the distal end the olfactory perception is weakened but not destroyed; on amputating the whole antennae the sense is almost, if not entirely, lost; covering the antennae with indiarubber was the same as cutting the antennae off; amputating the palpi resulted in only a very small decrease in olfactory perception from which Perris concluded that the palpi served only for olfactory recognition of substances near the mouth.

With *Cynips*, *Leucospis* and *Bembex* Perris found that they located their prey underground, or in wood, by means of their antennae, and that *Dinetes* could be completely confused by interpolating a piece of paper, or one's hand, between the insect itself and the place where the prey or eggs were hidden. Perris, having demonstrated the function of the antennae in insects and the rôle it plays in connection with the olfactory sense, remarked that the Araneida, the only Arthropoda without antennae, have rudimentary olfactory powers. Using *Philonthus aenus* before and after antennal amputation Hauser (1880) concluded that the seat of olfactory sense lies in the antennae.

Plateau (1876–1910), who did a considerable amount of work, supported the antennal theory, and Forel (1874–1908), although contesting much of Plateau's work, agreed on this point. Some extraordinary experiments were described by Forel where ants, deprived of their antennae, failed to locate their food and were unable to distinguish between friend and enemy. When they had the anterior part of the head dissected off as well as the entire abdomen they retained all their olfactory responses. Also a wasp, with the anterior portion of its head amputated, responded to a needle dipped in honey whilst a wasp without its antennae failed to respond to a similar stimulus. In the case of carrion beetles, loss of their antennae resulted in a loss of ability to locate putrid meat.

Still more evidence is brought forward by Mayer (1900) working on the mating instincts of the moth *Promethea.* Normally the males are attracted to the females and even after the entire abdomen of the male had been removed it still responded and was attracted to the female in the normal manner. Covering the antennae by means of photographic paste resulted in a cessation of any such desire to seek the female, and the males remained calm and unexcited even when placed within an inch of the female. Dissolving off the paste resulted in the restoration of the normal attraction. On covering again, the moth once more remained calm and passive when placed near the female.

Many other experimenters supported the antennal theory of olfaction such as Bethe (1898), de Blainville (1882), Donhoff (1854–1855), Erichson (1847), Kraepelin (1883), Kuster (1844), Leydig (1860), Desvoidy (1828), Raesel (1822–

1825), Slater (1848), Vogt (1851) and Wasmann (1899). With all these supporters the antennal location of the olfactory organs appeared to have been established.

(b) *Against theory of antennal location of olfactory organs.*

Grimm (1869) and Hauser (1880), experimenting with beetles, concluded that the antennae did not serve any olfactory purpose, and Hauser demonstrated, in certain of the Hemiptera and with some beetles, that, even after antennal amputation, response was obtained to odours such as turpentine and carbolic acid. It is unfortunate that such strong odours were used in these experiments, as there is always the possibility that they may be acting on the nerve endings other than those of olfaction.

Using ants (*Formica rufa*), flies (*Lucilia caesar*), and beetles (*Silpha thoracica*) Graber (1885) contended that after antennal amputation these insects still possessed olfactory perception. Thus Graber concluded that insects had no special olfactory centre, but that the olfactory organs were spread all over the insect's body. Forel (1908) criticised this view severely and regarded Graber's conclusions as unwarrantable. Again exception can be taken to the use of very strong smelling foods which might act on the gustatory as well as the olfactory sense. Also the numbers obtained and quoted by Graber cannot be regarded as completely convincing. Graber's work showed that *Silpha thoracica* reacted to such pungent substances as essence of rosemary, turpentine and butyric acid after antennal amputation. In the case of cockroaches Graber admitted that the antennae appeared to serve as the bearers of the olfactory organs, but he regarded this as being far from the general rule for insects. Working with *Necrophagus* Garnier (1860) agreed with the conclusions reached later by Graber. Porter (1883) and Landois (1865) took the same viewpoint on the problem.

These early experiments indicate that some olfactory organs occur on the antennae, but, especially where powerful odours are used, insects react even without their antennae. The subject is rapidly dividing itself into two schools of thought, and in order to follow the trend with greater clarity more recent experiments will be considered in some detail.

Experiments of Fielde and Barrows.

Fielde (1901–1907) supported the theory that the olfactory organs are located on the antennae and experimented as to the effect on olfactory perception when the antennae were amputated in varying degrees. She concluded that, when ants with different numbers of antennal segments amputated were observed, the segments of the antennae possessed specific powers of olfactory perception. The distal or twelfth segment was believed to recognise the " nest odour "; the eleventh segment recognised the inherent odour manifest over the body of the ant; this smell, a character inherited by the ant, is the same for all blood relations, the queen and workers of the same lineage –this detection was only possible when the eleventh segment came into actual contact with another ant. The tenth recognised the colony odour; the ninth the track made by the individual; the seventh and eighth the inert young, whilst the fifth and sixth recognised the odour of their enemies. Clipping the antennae with sharp scissors appeared to be the best method of antennal amputation and eighteen days after the operation 40% were still alive and apparently quite recovered. Until their recovery the ants were listless but very irritable if disturbed, and attacked any moving object that touched them. This observation is contrary to the result of Forel's work (1909), who reported that ants on antennal amputation did not fight. These observations of Fielde constitute the first attempt that has been made to assign definite olfactory functions to the various sensitive segments of the antennae and as such is a very interesting study.

Barrows (1907), dealing with *Drosophila ampelophila*, came to the conclusion that the antennae possessed all, or nearly all, the olfactory powers. The conclusions reached were :—that the fly's reaction to a range of odorous materials varied; that when the stimulus was weak only random movements occurred but, when stronger, these movements become more constant until the fly orientated itself in the direction of the stimulus; amputating one antenna resulted in the fly orientating itself by means of " circus movements," showing that normally the fly orientated itself by means of a response to an unequal stimulus of the antennae. An attempt was made to block out the antennae by covering them with a gum, but this method was unsuccessful. It was found that amputation of the antennae when the fly is under ether gave satisfactory results. Burning off the antennae, a method often used, was found to be too drastic.

The experiments of McIndoo.

At this stage evidence seemed to be accumulating rapidly in favour of antennal location of the olfactory organs. McIndoo (1914–1933) in a series of papers attempts to prove the contrary. It would be impracticable to outline all his experiments, and all that can be done is to show his conclusions and to discuss his principal methods.

In general McIndoo studied the reaction of different insects to oils of peppermint, thyme and wintergreen, and to such substances as honey and comb, pollen, honeysuckle flowers, leaves and stems of pennyroyal, leaves of spearmint and leaves and stems of sage. The method of procedure was to have small observation hives or boxes in which were placed the insects concerned. When the insects were quiet the odours were brought within a few inches of them. Recording reactions such as the insect's withdrawing or moving its antennae or legs, McIndoo obtained the average time taken to produce one of these reactions in the case of the various substances. With the essential oils the average reaction time for bees was 2·3 seconds. After obtaining the time with the normal insect the experiment was repeated, using the insects after amputation of one of the antennae. Strong objections were made by McIndoo to this amputation, since all insects after such operations lived only for a short period, were much less pugnacious and appeared to be without some means of communication. With such bees the average reaction time to the essential oils was 4·6 seconds. After amputating the segments of the remaining antennae one by one the reaction times were obtained for insects with the differing numbers of antennal segments intact. Complete amputation of both antennae resulted in the bees being unable to recognise strangers, they were likely to attack hivemates and they lived for a much shorter period.

The time reactions for bees after varying degrees of antennal amputation were :—

	Average reaction time.
2 antennae completely whole	2·3 seconds.
1 antenna amputated	4·6 ,,
1 antenna amputated and 2 joints of the other . .	15 ,,
,, ,, 4 ,, ,, . .	44 ,,
,, ,, 5 ,, ,, . .	56 ,,
,, ,, 6 ,, ,, . .	27 ,,
,, ,, 7 ,, ,, . .	98 ,,
,, ,, 8 ,, ,, . .	99 ,,

With both antennae pulled out they wandered aimlessly, rarely took food and lived only 19 hours. Cutting off the antennae at the base or covering them with shellac also produced this " crazy " condition. The results given above would appear to show that the antennae serve as the centre of the olfactory organs since, as the bee loses more antennal segments, so does its ability to react to the odours decrease. McIndoo, however, discounted the entire value of such experiments on the ground of the bee's abnormality. In support of this contention an experiment is described in which he carefully removed bees in the pupal condition from the comb, amputated their antennae and replaced the bees in their cells. These bees lived only five days after emergence, hence he concluded that they were abnormal. A criticism of this reasoning must be mentioned here. It can be said that the loss of such a vital structure as the antennae would naturally prejudice the chance of survival, since, because of its olfactory functions alone, such a loss would result in the insect having no means of selecting food. Fielde (1901–1904) has shown that ants deprived of their antennae can no longer find their way about the nest or even recognise their young, but she considered this behaviour due to the loss in olfactory power resultant on the loss of the antennae.

Further evidence of complete abnormality is offered by McIndoo, where it is shown that burning off the antennae resulted in only a few bees recovering sufficiently to eat candy or move normally. Using these bees he found that the average reaction time to the essential oils was only 4 seconds, and he regarded this as evidence that the loss of the antennae was not followed by a loss in olfactory perception. Only 7 bees were taken and, in spite of their admitted abnormality after the drastic method of amputation, McIndoo accepted their behaviour as evidence. Continuing on this line he took some bees and removed their antennal cleaners after which operation three-quarters recovered and appeared normal. The antennae of these were then covered with glue which the bees, since they were without their antennal cleaners, could no longer remove. The time response to the essential oils was then 2·9 seconds. By a control experiment it was shown that the glue did not interfere with the normal olfactory response. From the figures :—

	Average reaction time.
Normal bee with both antennae	2·6 seconds.
With glued antennae	2·9 ,,
With burnt off antennae	4·0 ,,

McIndoo argued that the slight increase in time could be accounted for by the increase in abnormality but, discounting this small increase, the figures showed that even without the antennae the bees reacted at more or less the same rate to the oils used. Therefore, he concluded, the olfactory sense was not in the antennae.

Considering the argument one cannot accept it without severe criticism. In the first place 90% of the evidence is disregarded on the score of abnormality of the insect after antennal operations, yet the remaining 10% is accepted without any such hesitation. On his own evidence he considered bees with waxed or coated antennae to be " crazy," yet he accepted results from insects with coated antennae. A more important point is that all these experiments, on bees and other insects with amputated antennae, were carried out using essential oils of wintergreen, thyme and peppermint. Such strong substances as these (in olfactory experiments) must meet with severe objections on the grounds that their oils are liable to act as an irritant and possibly in a gustatory manner and thus obscure any purely olfactory reaction. The close proximity at which these oils were offered supports this objection.

In connection with this point an experiment was described in which dead bees were placed on the alighting board of an experimental hive eight at a time on three consecutive days. The time taken for the bees in the hive to remove the dead bees was recorded, and varied from 35 seconds in one instance to 7 minutes 45 seconds in another, giving an average time of 3 minutes 11 seconds for removal of all the 24 bees. Repeating the experiment with the same dead bees, which had now a trace of oil of wintergreen on the thorax, the removal time varied from 10 seconds to 36 minutes with an average of 10 minutes 19 seconds for all. The repellent smell of the oil was taken as the cause for this increase, and this was regarded as proof of the olfactory stimulus due to the oil of wintergreen. This experiment may be considered in the opposite light—that is that the oil acts as a general irritant. The figures obtained are not given in more detail than quoted and from the very big range of the times it appears that the average times themselves can have no significance. In any case such wide variation must mean a very high percentage standard error, which throws doubt on the validity of an experiment with so few replicates.

McIndoo based all his conclusions on the results of numerous experiments, using essential oils. Hymenoptera, Coleoptera, Lepidoptera and Orthoptera were dealt with, especial attention being given to the honey-bee. From all this work he stated (1915) that " it seems that the antennae do not carry any of the olfactory organs, while the olfactory pores, found on the peduncles of the elytrae, on the dorsal surfaces of the wings, on the trochanters, tibiae, sometimes on the femur and tarsi, and perhaps on the mouth appendages, are the true olfactory organs in beetles." Similar conclusions were reached for the other orders. Working on the anatomical side of this problem he demonstrated olfactory pores on the wing-bases and legs, and claimed to have shown that these pores have no external chitinous membrane; he argued that such pores have the ability to act in an olfactory manner, whereas the pores of a like nature on the antennae where they have a covering of chitin fail to function in this way. Other workers, in particular Snodgrass (1926) and Newton (1931), have been unable to confirm this statement of the absence of a chitinous covering membrane on the so-called olfactory pores on the base of the wings and legs. It cannot be said that these pores act in an olfactory manner from McIndoo's evidence. The question of the anatomical structure of the olfactory organs is not within the scope of this paper, but mention may be made that a covering of chitin need not necessarily be a barrier to olfactory stimulation. Eidmann (1922) has shown that chitin is not impervious to alkalis and acids.

The Experiments of von Frisch.

Von Frisch (1919–1930) has done a considerable amount of work on the question of olfaction in insects, and his experiments are all the more acceptable in that they were conducted on bees in their natural habitat.

Marked bees were trained to go to four boxes in the field. In one of these boxes was placed a sugar solution and the same box also contained a small amount of a " flowery smelling oil." The bees became trained to go to this box for their sugar, and even when the boxes were changed about they still selected the scented box without hesitation. After amputating the antennae the bees were watched, the boxes having been moved into different relative positions, and it was seen that the bees entered all the boxes indiscriminately. The actual operation of amputation was done very carefully and the bees appeared normal afterwards, but, as a check against possible error due to shock, the entire experiment was repeated, but this time the sugary solution was placed in a box of a distinctive colour—blue. Amputation of the antennae failed to alter the association with this colour and the bees appeared normal. From this it was concluded that amputation of the antennae did not result in a shock sufficiently severe to influence any sensory reactions apart from those lost with the antennae. Von Frisch also ascertained that the olfactory power of the bee lies in the terminal eight segments of the antenna and that loss of these had the same effect as removal of the entire antenna. From these experiments von Frisch stated that the antennae alone are the seat of the olfactory organs.

The Experiments of Minnich.

Minnich (1921–1932) who was a pupil of von Frisch has done much to forward our knowledge on this problem. Previously most investigations had depended upon actual attraction to odours before and after antennal amputation. Minnich worked with insects which have extensible mouth-parts, and it is the extension of these mouth-parts upon stimulation that affords the basis for his work. By carefully controlling the nutrition of the insects, the extension of the mouth-parts may be regarded as an index of the reception of the stimulus. Butterflies were suspended over apple-juice extract at a distance of 2 cm. Using this method Minnich (1924) showed that in *Pieris rapae*, on amputating one antenna, the response decreased 6%, whereas, on amputating two, a drop of 45 to 77% was observed. Minnich believed that normally the antennae were the centre of the source of olfactory response, but admitted that in this case there must be other centres.

In interpreting the work on *Pieris rapae* the following consideration must be borne in mind. The main objection is taken to the method and the interpretations argued from the results. Minnich took a number of *Pieris* and found that several responded—by extension of the proboscis—either on handling or when they were placed over pure water. This readiness to respond was overcome by only using them after they were " standardised " when they did not respond to anything other than the apple juice. Thus 25% were disregarded on account of their refusal to be standardised and of the rest only 39% responded to the extract alone. Using insects which responded every time to this extract these insects had their antennae removed and the number of times they responded was taken. The response before antennal amputation was 100% and after between 18 and 50%. It was argued from this that there had been a loss of about half the olfactory power after amputation, and consequently olfactory organs must be elsewhere than on the antennae. This reasoning is not admissible. Assuming for the moment that the experiment is valid, then the fact that the insects respond after amputation can only be taken to show that the loss of the antennae does not result in the loss of the olfactory powers. The lower number of responses cannot be taken to show a comparative loss in the olfactory power since, if an insect can smell, it will respond, there can be no intermediate position. By disregarding all insects which responded to the control conditions Minnich selected for his experiment a non-normal population. It would have been more accurate to have taken a large number of *Pieris* and test their response to the juice and also to a control of water. If these results showed any significant difference for the apple juice then, and then only, should insects be used of which the antennae had been amputated. By comparing these results the part played by the antennae could be deduced by a complete statistical analysis. Finally, a minor point, throughout the experiments a commercial extract of apple juice was used. Although it is unlikely, the use of such an extract might bring in complications due to the presence of irritant substances, and this would bring the work into line with that of McIndoo.

The most important work done by Minnich has been in the demonstration of the presence of contact chemo-receptors on other parts of the insects' body than on the antenna, and this is closely allied to the olfactory response.

Recent Experiments.

Hartwell (1924) reported that there was a loss of olfactory sense for a period of time after anaesthetising the antennae of termites, indicating the connection between the antennae and the olfactory response. Yet there was also a marked response to essential oils after antennal elimination, but not to mild odours. Liebermann (1925) obtained a correlation between the number of sense-organs on the antennae and the olfactory requirements of certain Muscid flies. He demonstrated an increase of numbers of these sense-organs proportionate to the difficulty of finding food. Flies feeding on food from flowers that occur in profusion and are easily recognisable have only 494 sense-cones in pits and 1478 on the surface. Carrion flies feeding on substances which are more difficult to find, more widely scattered and which are impossible to distinguish by night, have 820 cones in pits and 2764 surface-cones. The Bot-flies, in which the relation between insect and host is very specialised, have 4683 sense-cones and 1700 surface-cones. This relationship strongly supports the opinion that the antennae carry the olfactory organs. Nevertheless it cannot be taken as evidence that it is only the antennae that have these organs. An examination for these cones on certain parts of the body might result in their being found on the body in the same ratio as they occur on the antennae. Since nothing is known of this, further work will have to be undertaken to settle such a point. Abbott (1927–1932) found that beetles, after antennal amputation, lived for long periods thus showing their comparative normality after the operation. Using such beetles he found that they still responded to certain odours. From this work Abbott considered that the olfactory organs were widely scattered over the insect's body. Unfortunately Abbott's work is not above criticism—he used rather strong odours in some instances. Also after covering over various parts of the insect's body with shellac he found that it responded even when the antennae were completely covered. Considerable doubt enters into this, since there is always the danger that the insect might have cleaned part of the antennae or that the shellac might have been pervious to the odours.

Glaser (1927) came to the conclusion that the antennae are used for long-distance olfactory perception and the palpi for short distances. This conclusion was reached from experiments using Roquefort cheese as the attractive substance for the American cockroach *Periplaneta americana*. Using ether, carbon tetrachloride, amyl and ethyl acetate he demonstrated that olfactory chemo-receptors were present on the antennae and the maxillary and labial palpi.

Valentine (1931) carried out much work as to the situation of the olfactory organs in the meal-worm beetle *Tenebrio molitor*. Sex attraction was used as the stimulus. Valentine found that the antennae-less male was unable to find the female and showed no excitement when brought near her. To test McIndoo's theory males with normal antennae were taken and the wing-bases and legs were covered with mineral oil—these males still evinced attraction to the females in the normal way. With only one antenna the beetle performed circus movements towards the source of the odour. All these results showed that the antennae carry the olfactory organs, and he further showed that they could be located in the apical four segments. As a check it was found that the beetle received its food stimulus (aqueous bran extract) through the same organs. Concerning the reactions of this beetle to essential oils it was shown that they have a very irritating effect, and Valentine considered them likely to affect organs normally concerned with the perception of other stimuli, as well as affecting the respiratory system. The essential oils still produced the same effects after the elimination of the four distal segments of the antennae. Even after all the possible centres had been coated with the mineral oil the insect still reacted to the essential oils, showing that such response cannot be due to olfactory stimulus. Valentine concluded that the antennae served as the seat of the olfactory organs, and essential oils of bergamot, thyme and clove reacted on other senses than that of olfaction.

Experiments carried out by the present writer (Marshall, 1935) showed that there is a possibility that the sense-organs cannot be grouped into rigid departments of olfaction and taste. The antennae of the honey-bee alone serve for the recognition of mild odours. Yet unless one admits a gradation in sensitivity of the sense-organs of contact chemo-reception on the same insect then it must be that the olfactory organs on the antennae serve also for the perception of contact chemical stimuli. If this is so then there can be no rigid barrier between olfactory and taste sensory organs.

For reliable information on the question of the olfactory response it is imperative that the experiments should satisfy various requirements. Hoskins and Craig (1934) and Marshall (1935) agree that the environment of the experiment should approach the normal as far as possible. Hoskins and Craig conducted their experiments at a fixed humidity and temperature using *Lucilia sericata* Meigen, of the same age and in the same state of nutrition. Marshall, working with *Apis mellifica* L., conducted his experiments also at a constant temperature and humidity and in this case the final experiments were made in the absence of light. The effect of light in olfactory experiments is of primary importance and the differential effect of light stimuli on the honey-bee nullified any response to olfactory stimuli. Hoskins and Craig consider that for valid results a large percentage of the individuals should show response and they criticise McIndoo's work (1933) on these grounds. They also point out the necessity of obtaining rapid results where short-lived insects are being used or where food is frequently required. The suggestion is put forward that prolonged exposure to an odour may result in the fatigue of the olfactory sense with a resulting fall in response and a corresponding increase in the effect of other conflicting stimuli. Marshall's findings are in agreement. Here in the first type of olfactometer described it was demonstrated that, using single bees at a time, the bees rapidly became fatigued and frequently made no decision. The final type of olfactometer used precluded this objection, twenty-five or fifty bees being used at the same time.

Apart from the necessity of ensuring a reliable basis for experimentation the question of what constitutes an ideal olfactory attractant is often a difficult point to decide. Whilst being a powerful olfactory attractant, in order that conflicting stimuli have a smaller chance of forcing a response, it should exclude the possibility of any action on sensory organs other than those of olfaction. Using secondary amyl mercaptan and methallyl thiocyanate Hoskins and Craig obtained a positive attraction and, whilst this was so for low concentrations, it changed to repulsion at higher concentrations. These workers presumed that the response shown was entirely a reaction to olfactory stimulus. In the case of honey-bees, Marshall showed that the contact chemo-receptors on the antennae and fore-tarsus are receptive to different strengths of sucrose solutions. An average strength of M/12 elicited a response when applied to the antennae, a strength of M/1 being necessary when applied to the fore-tarsus. From this the possibility suggests itself that the antennae must be able to detect the more dilute solutions either because they have situated upon them taste organs of greater perception, or it may be due to the activity of organs which normally perceive olfactory stimuli. If this is correct then there can be no rigid barrier between the concepts of taste and olfaction. Eltringham (1933) has demonstrated that there are spine-like chemo-receptive organs near the tarsal spines. These spines have a trichogen, cap cell and sensory cells, while the ordinary tarsal spines only have a trichogen. Whilst an overlapping of the senses may occur, yet, in so far as mild odours are concerned, it is concluded from experiments on bees, with the antennae amputated, that they no longer responded to olfactory attraction offered by bees-wax and that the antennae are the seat of all the olfactory organs perceptive of mild odours.

Associate Factors.

More recently Wigglesworth and Gillett (1934) have shown that in the blood-sucking bug *Rhodnius* the antennae bear the receptors of food stimulus but that olfaction only plays a small part, other factors having more effect. The attraction to the host at short distances is due, in the main, to the current of warm air which emanates from the body of the host. The smell of the skin is only a secondary influence. Both the olfactory and thermal senses are located in the antennae. Several other important facts also result from this work. If the insects are confronted with two stimuli they will select one and not attempt to make for some intermediate point. Also after complete amputation of the antennae *Rhodnius* can be made to react to the feeding stimulus either by moving things in front of the eyes, or, if the eyes are covered up, by vibration. Thus there must, in this example, be some interplay between the olfactory and thermal senses in the first place and to a lesser extent between those of sight and vibration.

The question as to the particular sense which influenced the insect to locate its food has always been a very controversial matter. Plateau (1876–1910) in his many papers advocated that the initial location of food was due to smell and was supported in this by Bethe (1902), Boulger (1878), Buttel-Reepen (1905–1915), Schroder (1901), and Zander (1913). This belief is strongly denied by Forel (1874–1910) as well as Andreae (1903), Detto (1905), von Dobkiewicz (1912), Focke (1889–1890), Giltay (1904–1906), Kienitz-Gerloff (1898–1903), Lovell (1912–1914), Lubbock (1882), Reeker (1898), Schenk (1902), and Werz (1904). All these observers were of the opinion that the main directing force was not one of smell alone but a resultant force obtained from impressions on many senses. Forel repeated many of Plateau's experiments and disagreed as to his findings and interpretations; in particular by the experiment in which the artificial flowers were placed in clumps of real flowers. Honey was placed on these artificial flowers and their attractiveness to bees was observed. Forel found that the bees did not visit them and concluded that they passed, in spite of the honey which attracted them, preferring the colour of the real flowers. Surely such experiments have very little value, von Frisch (1919) condemned this type of experiment on the grounds that using artificial flowers in a background of real flowers complicated the environment of the experiment too much. Honey is not accepted as having strong attractive powers for bees in the field. Most of the work done by these writers consisted of either offering artificial flowers among real flowers or by making some slight change in the condition of individual flowers. Any such experiments suffer from the lack of knowledge of the possible effect that such a minor change could have upon an insect in an uncontrolled environment.

Since the olfactory perception of insects has been proved it is certainly plausible to conceive that this ability is used in the location of food, and *a priori* one would admit of this possibility. There is always the point as to when the olfactory sense comes into play. Forel and his supporters would suggest that colour is the chief factor and that smell only influences the insect at short range.

Lineburg (1924) recently brought forward a very interesting hypothesis. From observations on the honey-bee when returning from taking its initial flight of discovery he found that during such flights the scent-glands are uncovered leaving behind, it was thought, a trail of scent thus enabling the other bees to follow. Both food and water, he contended, are not found by chance after the discovery by one bee but that all the others were led there by this track. For such a theory to be possible one must allow that the trail could prevail in the air for several seconds. No actual proof of such a track is given, the entire theory being based on morphological observations on the exposure of the scent-gland, and no corroborative evidence has yet come forward. Whilst the explanation is very plausible it is difficult to accept. It is the common belief amongst bee-keepers that bees find food and water mostly by chance but that once found memory enables them to find them again. It would seem more probable that the bee, after finding the food or water, on its return to the hive would stimulate the other bees to follow it on its second flight.

The whole point at issue is still unexplained : generally it is known that the insect certainly uses its senses of colour and olfaction to locate its food. Also other stimuli must enter into this attraction depending on the insect concerned; for example, in *Rhodnius* the main attractive element is the warm air currents received by the antennae, the olfactory recognition only plays a secondary part.

Stimulus reaction or response in insects is often taken as the criterion of olfactory perception. Mayer and Soule (1906) contributed a very important addition to our knowledge. Larvae of *Danaus plexippus* were used and it was found that their search for food was guided entirely by a chemical sense, and not by any inherent conception of the form or colour which the food should take. Once the larva had received this initial stimulus to eat given by the appropriate foodstuff it continued to eat even if this attractive food were taken away and replaced by one which normally it refused to eat. This continuation of eating in the face of what is an unpleasant change is due to what was termed " the momentum of reaction." * This " momentum of reaction " was used as the basis for an experiment—the initial momentum was obtained by feeding the larva on milkweed, and this was then replaced by an unpleasant food after varying intervals of time. If, after the larva had received the stimulus to eat, the milkweed were taken away and one and a half minutes later a distasteful food were offered, then it ate at the same rate as before. However, if this distasteful food were offered after an interval of thirty seconds it ate at a slower rate every time. Thus there is no associate memory lasting more than one and a half minutes, since if the distasteful food were offered thirty seconds after the pleasant food the larvae could remember the first taste and dislike the second by comparison. After one and a half minutes there seemed to be no such association. The question of this memory association is important, and the fact that a powerful initial attractive stimulus can be made to overcome a later unattractive stimulus must have special importance in olfactory experiments.

---

* Unfortunately no data were given as to how long normally unpalatable food was acceptable after this initial momentum of reaction had been given.

THE PRESENT POSITION OF THE SUBJECT.

The divergence of opinion which shows itself throughout the literature is greater than might reasonably be expected in view of the fact that the individual experiments are generally quite convincing. To take an example: many experimenters have used as a basis for their work insects before and after antennal amputation. Yet the very mode of such treatment is subject to severe criticism; McIndoo criticised this method on the grounds of abnormality evinced in the after-effects, whereas others are equally sure of the ability of the insects to recover and behave normally in subsequent experiments. Naturally this question of the normality of the insects after such treatment affects the validity of the results.

McIndoo regarded the sickly and irritable condition attendant upon the operation as being sufficient to indicate complete unsuitability for future work. At the same time von Frisch using colour sense as a check found that de-antennated bees responded normally to colour stimuli, and from observations on the habits of these bees found that they were apparently normal.

The loss of such a vital part as the antennae possessing so many sensillae must render the insect to some extent abnormal. Is this abnormality sufficient to interfere with the validity of olfactory experiments? In some insects it must be, although naturally it largely depends upon the particular insect in question and also upon the environment in which it is placed. There can be no doubt that in the hives or nests of insects where complete darkness prevails, the loss of antennae is a severe handicap. Fielde (1901) stated that, after the loss of the sensitive antennal segments, ants no longer took any interest in the life of the colony and died in a very short time. Nevertheless, dealing with insects such as the bee, where vision plays a more important part, the loss of the antennae, even if rendering the insect somewhat abnormal, does not seem to produce any effects likely to prejudice experiments. From the evidence at hand most insects seem to withstand such amputation with little change in their general behaviour. Numerous experiments, using insects whose antennae have been put out of action by covering them with some impervious substance, generally agree with the work done on de-antennated insects. It would appear therefore that careful removal of these organs is not detrimental to the validity of the experiment, although there is the possibility that abnormal results may be obtained from some insects which have become unhealthy as a result of amputation. Such insects must be watched for and immediately discarded. The greater danger, however, is that the removal of the antennae may not only lead to the loss of the olfactory sense but also to the loss of the other senses which are centred in the antennae. These other senses may act in an associate way with the olfactory sense so that the resulting behaviour may be due, not to the loss of the olfactory sense alone, but to all. Again, in other experiments, conclusions supporting the antennal theory of olfaction have been drawn from the reactions of male to female insects before and after loss of the antennae. The assumption made in this case is that the attraction is one of smell. No doubt this is so in most cases, but sex reaction may be the result of the various sex stimuli acting on different sensillae on the antennae and not only on the olfactory organs.

Little is known as to the limits of the various senses in insects, and there seems a marked inclination in the majority of observers to assume that they are strictly analogous to those known to occur in the Vertebrata. Here the senses are said to be distinct. In insects also all must react through stimuli received from chemical solutions acting on nerve endings. From a chemical standpoint the differences associated with the senses of smell, taste and the general chemical sense must be due either to the fact that these senses differ in their chemical sensitivity, that is, they respond to different kinds of chemical substances, or they only differ in that they respond to specific dilutions. There is no direct means of determining which view is correct. If it is the first, then the senses are truly distinct; if, however, the second view is more correct, then it is merely a matter of ability to recognise various concentrations. The range of perception of smell varies greatly in different insects. Some butterflies by a contact stimulus through the tarsal organs can detect apparently infinitesimal dilutions whereas other insects react only to relatively strong concentrations. This is a contact stimulus through the tarsal organs and therefore more akin to taste. In the Insecta there is no reason to suppose that the principle of the method of olfactory perception varies at all, and so it would seem that it is merely a question of fineness of structure which results in an ability to detect different orders of concentrations. In insects this constitutes the difference associated in the vertebrates with the senses of taste and smell.

McIndoo regards the senses under discussion as not distinct, and there can be no doubt that a clear-cut division has yet to be proved.

The whole question of the senses, the interplay between them, and the difficulty of deciding the exact effect of a stimulus upon any one of them renders experimentation very difficult and the results often very inconclusive. Wigglesworth and Gillett (1934) have shown that *Rhodnius* is unable to locate its host when the antennae are cut off, but that olfactory detection is one of the lesser deciding factors. What is regarded as olfactory response may be the summation of the effects of varying stimuli on different sense-organs.

Crozier (1915) states from work on the frog that a portion of a sensitive surface responds as well, and to the same extent, to a given stimulus as does the complete sensitive area. It is interesting in this connection to note that many workers have found that cutting of different amounts of the antenna resulted in a decrease in the rate of olfactory response. These workers explained this on the grounds that the rate of reaction is proportional to the number of sense-organs. Amputation of the segments of the antenna gradually lowers this number and so also does the rate of reaction decrease. Fielde assigns specific capabilities of olfactory detection to the different segments of the antennae.

Assuming the more sensitive olfactory organs to be situated on the distal end of the antennae, it follows that amputation of these parts will result in a far greater loss of ability to smell than will the removal of the proximal end; in fact, the complete loss of perception of some odours may result.

The entire question of olfaction is so involved owing to the extreme complexity and uncertainty of the sense boundaries that its interpretation depends largely upon the personal bias of the worker. Surveying the literature one can come to several definite conclusions :—

(*a*) There can be no change in the opinion that the antennae serve as the main centre of the olfactory organs.

(*b*) Considering the question as to the location of the olfactory organs on parts of the body other than the antennae there is much conflicting evidence. In particular McIndoo and Abbott have given instances of olfactory attraction after antennal amputation. All their work was carried out using strong odours which might reasonably be objected to on account of their concentration affecting other sensillae than those of olfaction. Minnich's work on *Pieris rapae* would show olfactory reception on parts of the body other than the antennae even where apple juice, quite a normal odorous substance, was used. This experiment cannot be accepted too readily on account of the method and the interpretations put on the results.

It is clear that normally the antennae are the seat of the olfactory organs. On the other hand, it is possible that the contact chemo-receptors on the body may be able to perceive exceptionally strong odours. This perception, because of its abnormality, cannot be regarded as a true expression of the functions of such organs. The action of any strong odours may be to affect various non-olfactory sensillae and possibly the respiratory system itself.

(*c*) The claim made by McIndoo that the wing-bases serve as a centre for the olfactory organs has not been corroborated from the morphological or experimental side and must be dismissed.

(*d*) The ability of the mouth-parts to perceive olfactory stimuli has not been established.

(*e*) A possibility that suggests itself is that all organs responsible for the detection of chemical stimuli are essentially the same in operation. The theory that appertains to vertebrates that what is smelled is not tasted does not apply to insects. The honey-bee can both taste and smell honey and sucrose solutions. Those organs the fineness of whose structure enables them to perceive olfactory stimuli are grouped on the antennae. The organs situated on the rest of the body are able to perceive only stronger stimuli—taste—and perhaps exceptionally powerful odours. The difference associated between these types of organs may be accounted for possibly by the thickness of the layer of chitin.

SUMMARY.

1. The literature of the olfactory sense is reviewed with especial reference to the limits of the sense and the location of the organs concerned. The various conceptions as to the chemical senses in insects are given.

2. The early writers attributed olfactory perception to most parts of the insect's body in turn, depending largely on the personal bias of the worker.

3. The question as to whether sex attraction may be used as the attractive stimulus is discussed and it is concluded that, although sex attraction may itself be the result of stimuli, some of which act possibly in a non-olfactory manner, yet at close range the attraction can be regarded as being olfactory in nature.

4. The early experiments attempting to describe the situation of organs of olfactory perception are reviewed. Those which contend that these are located on parts of the insect's body other than on the antennae are criticised because they use strong-smelling foods as the attractive principle which might act on the gustatory and other non-olfactory centres.

5. The experiments of Fielde and Barrows show that the antennae are the centre of olfactory perception, that amputating the antennae does not result in a sickly condition, and that the stronger the stimulus the more certain the response.

6. McIndoo's experiments are reviewed in detail. Exception is taken to his interpretations of his results. The use of essential oils is also considered an additional complication. His theory that the olfactory organs are not situated on the antennae is not accepted.

7. The work of von Frisch is outlined. His colour check on the effect of antennal amputation is regarded as strong proof that amputation does not result in abnormality sufficient to prejudice olfactory experiments.

8. The olfactory experiments of Minnich are summarised. It is thought that his method and interpretation with *Pieris rapae* are open to criticism.

9. Recent experiments show that anaesthetising the antennae results in loss of olfactory power. Correlations between the number of sensory organs on the antennae with the olfactory requirements of different insects show a strong positive correlation. Recent work supports the view that the olfactory organs are located on the antennae, although the possibility that the olfactory organs may also act as receptors of contact chemical stimuli is suggested. The use of essential oils in experiments for determining the olfactory response cannot be accepted.

10. Reviewing the influence of associate factors on olfactory response, it is concluded that it is extremely difficult to isolate the effect of any one stimulus upon any one sense organ. The observed response is often the resultant of many stimuli, or it is the response to a stimulus other than the one believed to be operating.

11. The experiments are reviewed collectively. Consideration is given to the operation of the senses of olfaction and contact chemo-reception. No conclusive evidence is obtainable from the literature, but it is suggested that the distinctions may not be as rigid as generally believed.

ACKNOWLEDGEMENTS.

The writer wishes to thank Sir John Russell for the courtesy extended in being allowed to work at the Rothamsted Experimental Station and to express gratitude to Dr. C. B. Williams for all the help and interest shown. It is desired to acknowledge the very generous help of Mr. H. C. F. Newton in making this review possible as well as to thank Miss A. M. Lysaght for assistance in reading the manuscript.

The work was carried out during the tenure of an Empire Cotton Growing Corporation Scholarship.

REFERENCES.

ABBOTT, C. E. (1927*a*). Experimental data on the olfactory sense of Coleoptera, with special reference to Necrophori. *Ann. ent. Soc. Amer.*, **20** : 207–216.

—— (1927*b*). Further observations on the olfactory powers of Necrophori. *Ibid.*, **20** : 550–553.

—— (1928). The tarsal chemical sense of the screw worm, *Cochliomyia macellaria* Fab. *Psyche*, **35** : 201–204.

—— (1932). The proboscis response of insects, with special reference to blowflies. *Ann. ent. Soc. Amer.*, **25** : 241–244.

ANDREAE, E. (1903). Inwiefern werden Insekten durch Farbe und Duft der Blumen angezogen? *Bot. CBl. Beiheft*, **15** : 427–470.

BALBIANA, E. G. (1866). Note sur les antennes servant aux insectes pour la recherche des sexes. *Ann. Soc. ent. Fr.*, **6** : 38.

BARROWS, W. M. (1907). Reactions of the Pomace Fly, *Drosophila ampelophila* Loew, to odorous substances. *J. exp. Zool.*, **4** : 515–537.

BASTER (see Lehmann, M. C. G., 1798).

BETHE, A. (1898). Dürfen wir Ameisen und Bienen psychische Qualitäten zuschreiben. *Pfluger's Arch.*, **70** : 15.

—— (1902). Die Heimkehrfähigfeit der Ameisen und Bienen. *Biol. CBl.*, **22** : 199–215, 234–238.

Blainville, H. de (1882). Principes d'anatomie comparée, **1** : 339.

Bonsdorf, G. (1872). Fabrica, usus et differentiae palparum in insectis. Dissertatio. *Aboae.*

Boulger, G. S. (1878). Scent and colour in flowers. *Nature,* **18** : 427–428.

Burmeister, H. (1836). Manual of Entomology. Trans. W. Shuckard : 297–298.

Buttel-Reepen, H. von (1905). Der Geruchsinn der Bienen. *Bienenwirtsch. CBl.,* **1905** : 99.

—— (1908). Das Geruchsvermögen der Bienen. *Ibid.,* **1908** : 356–357.

—— (1909). Das angeblich schlechte Geruchsvermögen der Bienen. *Ibid.,* **1909** : 3–5 ; 35–37.

—— (1915). Leben und Wesen der Bienen, *Braunschweig.*

Comparetti, A. (1800). Dinamica animale degli insetti, *Padova,* **2** : 442.

Cornalia, E. (1856). Monografia del bombice del gelso. *Mem. Inst. Lombardo Sci. Milan,* **6** : 304–305.

Crozier, W. J. (1915). Ionic antagonism in sensory stimulation. *Amer. J. Physiol.,* **39** : 297–302.

Cuvier, G. L. C. D. (1799–1805). Leçons d'anatomie comparée, **2** : 675.

Desvoidy, R. (1828). Recherches sur l'organisation vertebrale des crustaces et des insectes. *Paris.*

Detto, C. (1905). Blutenbiologische Untersuchungen. ii. Versuche über die Blutenorientierung und das Lernen der Honigbiene. *Flora,* **94** : 424–461.

Dobkiewicz, L. C. von (1912). Beitrag zur Biologie der Honigbiene. *Biol. CBl.,* **32** : 664–694.

Donhoff (1854–55). Uber das Geruchsorgan der Bienen, *Eichstadt. Bienenztg.,* **10** : 231 ; **11** : 44.

Dugés, A. (1838). Traité de physiologie comparée, **1** : 160–161.

Duméril, A. M. C. (1823). Considérations générales sur la classe des insectes. *Strasbourg.* : 25.

Eidmann, H. (1922). Die Durchlässigkeit des Chitins bei osmotischen Vorgängen. *Biol. CBl.,* **42** : 429–435.

Eltringham, H. (1933). On the Tarsal Sense Organs of Lepidoptera. *Trans. R. ent. Soc. Lond.,* **81** : 33–36.

Erichson, G. F. (1847). De fabrica et usa antennarum in insectis. *Berlin.*

Fabre, J. H. (1879–1904). Souvenirs entomologiques. *Paris,* **23, 24, 25.**

Fielde, A. M. (1901). A Study of an ant. *Proc. Acad. nat. Sci. Philad.,* **53** : 425–559.

—— (1901). Further Study of an ant. *Ibid.,* **53** : 521–544.

—— (1903). Artificial mixed nests of ants. *Biol. Bull.,* **5** : 320–325.

—— (1904). Power of recognition among ants. *Ibid.,* **7** : 227–250.

—— (1907). Suggested explanations of certain phenomena in the lives of ants, with a method of tracing ants to their respective communities. *Ibid.,* **13** : 134–137.

Focke, W. O. (1889). Blumen und Insekten. *Abh. naturw. Ver. Bremen,* **10** : 437–438.

—— (1890). Versuche und Beobachtungen über Kreuzung und Fruchtansatz bei Blütenpflanzen. *Ibid.,* **11** : 412–422.

Forel, A. (1874). Les fourmis de la Suisse. (Ouvrage Soc. Helvetique des Sci. nat.) *Genève.*

—— (1878). Der Giftapparat und die Analdrusen der Ameisen. *Z. wiss. Zool.,* **30** : 61.

—— (1885). Études myrmécologiques en 1884. *Bull. Soc. vaudoise Sci. nat.,* (2), **20** : 334.

—— (1908). The Sense of Insects. Translated by M. Yearsley. *London.*

Frisch, K. von (1919). Über den Geruchsinn der Bienen und seine blütenbiologische Bedeutung. *Zool. Jahrb.* (*Physiol.*), **37** : 1–238.

Frisch, K. von (1919). Zur alten Frage nach dem Sitz des Geruchsinnes bei Insekten. Verusuche an Bienen. *Verh. zool-bot. Ges. Wien.*, **69** : 17–26.

—— (1927). Versuche über den Geschmacksinn der Bienen. *Naturwiss.*, **15** : 1–20.

—— (1928). *Ibid.*, **16** : 307–315.

—— (1930). *Ibid.*, **18** : 169–174.

Garnier, M. J. (1860). De l'usage des antennes chez les insectes. *Mem. Acad. Sci. Amiens*, (2) **1** : 489–501.

Giltay, E. (1904) (1906). Über die Bedeutung der Krone bei den Blüten und über das Farbenunterscheidungsvermögen der Insekten, i. *Jb. wiss. Bot.*, **40** : 368–402; ii. **43** : 468–499.

Glaser, R. W. (1927). Evidence in support of the olfactory function of the antennae of insects. *Psyche*, **34** : 209–215.

Graber, V. (1885). Vergleichende Grundversuche über die Wirkung und die Aufnahmestellen chemischer Reize bei den Tieren. *Biol. CBl.*, (5) **13** : 385–398.

—— (1887). Neue Versuche über die Function der Insektenfühler. *Ibid.*, (7) **1** : 13–19.

Grimm, O. V. (1869). Beitrag zur Anatomie der Fühler der Insekten. *Bull. Acad. imp. Sci. St. Petersbourg.* **14** : 66–74.

Hartwell, R. A. (1924). A study of the olfactory sense of termites. *Ann. ent. Soc. Amer.*, **17** : 131–160.

Hauser, G. (1880). Physiologische und histologische Untersuchungen über das Geruchsorgan der Insekten. *Z. wiss. Zool.*, **34** : 367–403.

Hoskins, W. M., and Craig, R. (1934). The Olfactory Responses of Flies in a New Type of Insect Olfactometer. 1. Theory and Design of Olfactometer. *J. econ. Ent.*, **27** : 1029–1036.

Huber, F. (1814). Nouvelle observations sur les abeilles, **2** : 375–393.

Joseph, G. (1877). Ueber Sitz und Bau der Geruchsorgane bei den Insekten. *Verh. deuts. Naturf. Aerzte, Munchen*, **50** : 174–176.

Kienitz-Gerloff (1898) (1903). Prof. Plateau und der Blumentheorie. i, *Biol. CBl.*, **18** : 417–425; ii, *ibid.*, **23** : 557–562.

Kirby, W., and Spence, W. (1826). Introduction to Entomology. *London*, **3** : 455–456; **4** : 249–255.

Knoch (see Lehmann, M. C. G., 1798).

Kraepelin, K. (1883). Ueber die Geruchsorgane der Gliederthiere. *Osterprogr. Realschule Johanneums*, **25** : Hamburg.

Kuster, H. C. (1844). Zoologische Notizen. *Isis* (*Oken*), **1844** : 647–655.

Landois, H. (1865). *Arch. mikr. Anat.*, **4** : 88.

Lefebvre, A. (1838). Note sur le sentiment olfactif des antennes. *Ann. Soc. ent. Fr.*, **7** : 395–399.

Lehmann, M. C. G. (1798). De sensibus externis Animalium exsanguium, k. *Gottingae.*

—— (1799–1800). De antennis Insectorum, 2 Pt. *Londini*, &c.

Leydig, F. (1860). Ueber Geruchs- und Gehörorgane der Krebse und Insecten. *Müller's Arch.*, **1860** : 265.

Liebermann, A. (1925). Correlation zwischen den antennalen Geruchsorganen und der Biologie der Musciden. *Z. Morph. Ökol. Tiere*, **5** : 1–97.

Lineburg, B. (1924). Communication by scent in the honeybee—a theory. *Amer. Nat.*, **58** : 530–537.

Lovell, I. H. (1912). The Color Sense of the honey-bee : the pollination of green flowers. *Amer. Nat.*, **46** : 83–107.

—— (1914). Conspicuous flowers rarely visited by insects. *J. anim. Behav.*, **4** : 147–175.

Lubbock, J. (1882). Ants, Bees and Wasps. *London.*

Marshall, J. (1935). On the Sensitivity of the Chemoreceptors on the Antennae and Fore-Tarsus of the Honey-Bee, *Apis mellifica* L. *J. exp. Biol.*, **12** : 17–26.

Mayer, A. G. (1900). On the mating instinct in moths. *Ann. Mag. nat. Hist.*, (7) **5** : 183–190.

Mayer, A. G., and Soule, C. G. (1906). Some Reactions of Caterpillars and Moths. *J. exp. Zool.*, **3** : 415–433.

McIndoo, N. E. (1914*a*). The Olfactory Sense of the Honey-Bee. *J. exp. Zool.*, **16** : 265–346.

—— (1914*b*). The Olfactory Sense of Hymenoptera. *Proc. Acad. Nat. Sci. Philad.*, **66** : 294–341.

—— (1914*c*). The Olfactory Sense of Insects. *Smithson. misc. Coll.*, **67** (2) : 1–63.

—— (1915). The Olfactory Sense of Coleoptera. *Biol. Bull.*, **28** : 407–460.

—— (1917). The Olfactory Organs of Lepidoptera. *J. Morph.*, **29** : 33–484.

—— (1918). The Olfactory Organs of Diptera. *J. comp. Neur.*, **29** : 457–484.

—— (1920*a*). The Olfactory Sense of Orthoptera. *Ibid.*, **31** : 405–427.

—— (1920*b*). The Senses of Insects. *Ann. Rep. Smithson. Inst.*, **1920** : 461–483.

—— (1926*a*). Senses of the Cotton boll weevil—an attempt to explain how plants attract insects by smell. *J. agric. Res.*, **33** : 1095–1141.

—— (1926*b*). An Insect Olfactometer. *J. econ. Ent.*, **19** : 545–571.

—— (1927). Smell and Taste and their Applications. *Sci. Month.*, **1927** : 481–503.

—— (1929). Tropisms and Sense organs of Lepidoptera. *Smithson. misc. Coll.*, 81. (10) : 1–59.

—— (1931). Tropisms and Sense organs of Coleoptera. *Ibid.*, **82** (18) : 1–70.

—— (1933). Olfactory Response of Blowflies, with and without antennae, in a wooden Olfactometer. *J. agric. Res.*, **46** : 607–625.

Meinert, F. (1860). Bidrag til de danske Myrers Naturhistorie. *K. danske Vidensk. Selsk. Skrift.*, (5) **5**.

Minnich, D. E. (1921). An experimental study of the tarsal receptors of two nymphalid butterflies. *J. exp. Zool.*, **23** : 173–203.

—— (1922*a*). The chemical sensitivity of the tarsi of the Red Admiral butterfly, *Pyrameis atalanta*. *Ibid.*, **35** : 57–81.

—— (1922*b*). A quantitative study of tarsal sensitivity to solutions of saccharose in the Red Admiral butterfly. *Ibid.*, **36** : 445–457.

—— (1926*a*). The chemical sensitivity of the tarsi of certain muscid flies. *Biol. Bull.*, **51** : 166–178.

—— (1926*b*). The organs of taste on the proboscis of the blowfly, *Phormia regina* Meigen. *Anat. Rec.*, **34** : 126.

—— (1929*a*). The chemical sensitivity of the legs of the blowfly *Calliphora vomitoria* Linn., to various sugars. *Z. vergl. Physiol.*, **11** : 1–55.

—— (1929*b*). Chemical Senses of Insects. *Quart. Rev. Biol.*, **4** : 100–112.

—— (1931). The sensitivity of the oral lobes of the Blowfly, *C. vomitoria* Linn., to various sugars. *J. exp. Zool.*, **60** : 121–139.

—— (1932). The Contact Chemo-receptors of the Honey-Bee *Apis mellifera* Linn. *Ibid.*, **61** : 375–393.

Newton, H. C. F. (1931). On the so-called " Olfactory Pores " in the Honey-Bee. *Quart. J. Micr. Sci.*, **74** : 647–668.

Paasch, A. (1873). Von der Sinnesorganen der Insekten im allgemeinem, von Gehor-und Geruchsorgan im besondern. *Arch. f. Naturgesch.*, **39** : 248–275.

Parker, G. H. (1922). Smell, Taste and allied Senses in the Vertebrates. *Philadelphia*, 192 pp.

Parker, G. H., and Stabler, E. M. (1913). On certain distinctions between taste and smell. *Amer. J. Physiol.*, **32** : 220–240.

Perris, Ed. (1850). Mémoire sur la Siége de l'odorat dans les Articulés. *Ann. Sci. nat.* (*Zool.*), **14** (3) : 147–178.

Plateau, F. (1876). L'instinct des insectes peut-il être mis en défaut par des fleurs artificielles ? *C.R. Ass. franç. Avanç. Sci.*, **5** : 535–540.

—— (1886). Une expérience sur la fonction des antennes chez la Blatte (*Periplaneta orientalis*). *Bull. Ann. Soc. ent. Belg.*, **30** : 118–122.

PLATEAU, F. (1895). Comment les fleurs attirent les insectes? Recherches experimentales. 1. *Bull. Acad. Sci. Belg.*, (3) **30** : 466–488.

—— (1896). 2, *ibid.*, (3) **32** : 505–534.

—— (1897*a*). 3, *ibid.*, (3) **33** : 17–41.

—— (1897*b*). 4, *ibid.*, (3) **34** : 601–644.

—— (1897*c*.) 5, *ibid.*, (3) **34** : 847–881.

—— (1898). Nouvelles recherches sur les rapports entre les insectes et les fleurs. 1. Étude sur le rôle de quelques organes dits vexillaires. *Mem. Soc. zool. Fr.*, **11** : 339–375.

—— (1899). 2, Le choix des couleurs par les insectes. *Ibid.*, **12** : 336–370.

—— (1900). Expériences sur l'attraction des insectes par les étoffes colorées et les objets brillants. *Ann. Soc. ent. Belg.*, **44** : 174–188.

—— (1901). Observations sur le phénomena de la constance chez quelques Hyménoptères. *Ibid.*, **45** : 56–83.

—— (1902). Observations sur les erreurs commises par les Hyménoptères visitant les fleurs. *Ibid.*, **46** : 113–129.

—— (1902). Les pavots décorollés et les insectes visiteurs.—Expériences sur le *Papaver orientale L. Bull. Acad. Belg.* (*Cl. Sci.*), **1902** : 657–684.

—— (1905). Note sur l'emploi d'une glace étamée dans l'étude des rapports entre les insectes et les fleurs. *Ibid.*, **1905** : 403–422.

—— (1904–1906).—Les fleurs artificielles et les insectes. *Mem. Acad. Belg.* (*Cl. Sci.*), **1**.

—— (1906). Note sur l'emploi de récipients en verre dans l'étude des rapports entre les insectes et les fleurs. *Bull. Acad. Belg.* (*Cl. Sci.*), **1906** : 741–775.

—— (1907). Les insectes et la couleur des fleurs. *Ann. psychol.*, **13** : 67–79.

—— (1910). Recherches expérimentales sur les fleurs entomophiles peu visitées par les insectes, rendues attractives au moyen de liquides sucrés odorants. *Mem. Acad. Belg.* (*Cl. Sci.*), (2), **2**, 54 pp.

PORTER, C. J. A. (1883). Experiments with antennae of insects. *Amer. Nat.*, **17** : 1238–1245.

POULTON, E. B. (1928). An adaptation which tends to prevent in-breeding in certain Lepidoptera. *Proc. ent. Soc. London*, **2** : 75–82.

RAMDOHR, K. A. (1811). Ueber die Organe des Geruchs und Gehors der Gemeinen Biene. *Mag. Ges. naturf. Freunde Berlin*, **5** : 386–390.

REEKER, H. (1898). Wie ziehen die Blumen Insekten an? *Zool. Garten*, **39**.

RILEY, C. V. (1894). The Senses of Insects. *Insect Life*, **7** : 33–41.

—— (1895). The Senses of Insects. *Nature*, **52** : 209.

ROESEL, A. J. (1822–25). Insecten Belustigungen.

ROSENTHAL, F. C. (1811). Ueber der Geruchs organ der Stuben- und Schmeissfliege. *Arch. Physiol.*, **10** : 427.

SCHENK, O. (1902). Die antennalen Hautsinnesorgane einiger Lepidopteren und Hymenopteren mit besonderer Berucksichtigung der sexuellen Unterschiede. *Zool. Jahrb.* (*Anat.*), **17** : 573–618.

SCHIEMENZ, P. (1883). Ueber das Vorkommen des Futtersaftes, etc., der Biene. Dissertation. *Leipzig.*

SCHRÖDER, C. (1901). Experimentelle Studien über den Blütenbesuch, besonders der *Syritta pipiens* L. *Allgem. Z. Ent.*, **6** : 181–183.

SERRES, M. DE (1800). De l'odorat et des organes qui paraissant en être le siége chez les orthoptères. *Ann. Mus. Hist. nat., Paris*, **17** : 426.

SLATER, J. W. (1848). On the functions of the antennae of Insects. *Zoologist*, **6** : 2175–2177.

SNODGRASS, R. E. (1926). The morphology of insect sense organs and the sensory nervous system. *Smithson. misc. Coll.*, **77** : (8) : 1–80.

TREVIRANUS, G. R. (1816). Ueber den Sitz des Geruchssinns bey den Insekten. *Vermischte Anat. Physiol.*, **1** : 146–155.

VALENTINE, J. M. (1931). The Olfactory Sense of the adult mealworm beetle, *Tenebrio*. *J. exp. Zool.*, **58** : 168–228.

VOGT, C. (1851). *Zoologische Briefe*, **1** : 516.

WASMANN, E. (1899). Die psychischen Fähigkeiten der Ameisen. *Zoologica, Stuttgart*, **26**, 131 pp.

WERY, J. (1904). Quelques expériences sur l'attraction des abeilles par les fleurs. *Bull. Acad. Belg.*, **1904** : 1211–1261.

WIGGLESWORTH, V. B., and GILLETT, J. D. (1934). The Function of the Antennae in *Rhodnius prolixus* (Hemiptera) and the Mechanism of Orientation to the Host. *J. exp. Biol.*, **11** : 120–139.

WOLFF, C. B. J. (1875). Das Reichorgan der Biene nebst einer Beschreibung des Respirationswerkes der Hymenopteren, etc. *N. Acta Leop. Carol. Akad. Naturf.*, **38** : 1–251.

WRIGHT, F. R. E. (1929). The Attractive Force in Assembling insects. *Ent. Mon. Mag.*, **65** : 265–266.

ZANDER, E. (1913*a*). Das Geruchsvermögen der Bienen. *Biol. CBl.*, **33** : 711–716.

—— (1913*b*). Das Leben der Biene. *Stuttgart.*

ADDENDA.

In the period intervening between Mr. Marshall writing this paper and the preparation of it for the press, several additional papers of importance relating to the subject have been brought to our notice. Thanks to the help of Dr. A. D. Imms, F.R.S., and Mr. H. C. F. Newton, who in the first place helped Mr. Marshall considerably in the paper, the following list has been compiled. Mr. Marshall was unable to do this himself owing to his absence abroad.—C. B. WILLIAMS.

ANDERSON, A. L. (1932). The sensitivity of the legs of common butterflies to sugars. *J. exp. Zool.*, **63** : 235–59.

DITMAN, L. P., and CORY, E. N. (1933). The response of corn earworm moths to various sugar solutions. *J. econ. Ent.*, **26** : 109–15.

FRAENKEL, G. (1931). Die Mechanik der Orientierung der Tiere im Raum. *Biol. Rev.*, **6** : 36–87.

FRISCH, K. v. (1934). Ueber den Geschmackssinn der Biene. Ein Beitrag zur vergleichenden Physiologie des Geschmacks. *Z. vergl. Physiol.*, **21** : 1–156.

HANSTRÖM, B. (1926). Einige Experimente und Reflexionen über Geruch, Geschmack und den allgemeinen chemischen Sinn. *Z. vergl. Physiol.*, **4** : 528–44.

HOSKINS, W. M., and CRAIG, R. (1934). The olfactory responses of flies in a new type of olfactometer. *J. econ. Ent.*, **27** : 1029–36.

KUNZE, G. (1927). Einige Versuche über den Geschmacksinn der Honigbiene. *Zool. Jahrb.* (*Allg. Zool.*), **44** : 287–314.

—— (1933). Einige Versuche über den Antennengeschmackssinn der Honigbiene. *Ibid.*, **52** : 465–512.

MCINDOO, N. E. (1934). Chemoreceptors of Blowflies. *J. Morph.*, **56** : 445–75.

Author's abstract.

This paper deals with the morphology of all the so-called gustatory and olfactory organs of blowflies, and describes tests conducted to determine whether these insects taste with their tarsi and smell with their antennae and palpi. Antennae bear two types of so-called olfactory hairs, while palpi bear only one. With the aid of an olfactometer it has been shown that antennae and palpi do not bear the olfactory organs.

In order to explain the proboscis response, described by Minnich, it is not necessary to assume that tarsi bear gustatory organs, because : (1) a tarsus bears no sense-organs, except nine olfactory pores ; (2) it is almost impossible to wet the tarsi with water or sugar water; and (3) when flies were in the proper nutritive condition and liquids were about 3 mm. from the tarsi, the insects were induced by a special method to exhibit the proboscis response. It was further clearly demonstrated by a similar method that tarsi can easily distinguish between chemically pure saccharose water and distilled water when these liquids are about 3 mm. from the tarsi. The reponses, obtained by any method, are caused by two stimuli, one mechanised and the other olfactory. The act of touching the feet produces the initial stimulus and brings the liquids almost in contact with the olfactory pores on the tarsi.

MURR, L. (née DANIELCZICH) (1930). Ueber den Geruchsinn der Mehlmottenschlupfwespe *Habrobracon juglandis* Ashmead. Zugleich Beitrage zum Orientierungsproblem. *Z. vergl. Physiol.*, **11** : 210–70.

VANSELL, G. H. (1934). Relation between the Nectar Concentration in Fruit Blossoms and the Visits of Honeybees. *J. econ. Ent.*, **27** : 943–5.

WARNKE, G. (1931). Experimentelle Untersuchungen über den Geruchssinn von *Geotrupes silvaticus*, Panz. und *Geotrupes vernalis* Lin. Zugleich ein Beitrag zur Problem der Orientierung der Tiere im Raum. *Z. vergl. Physiol.*, **14** : 121–99.

WEBER, H. (1930). Biologie der Hemipteren. *Berlin*, vii + 543 pp.

WEIS, I. (1930). Versuche über die Geschmacksrezeption durch die Tarsen des Admirals, *Pyrameis atalanta* L. *Z. vergl. Physiol.*, **12** : 206–48.

WIGGLESWORTH, V. B. (1934). Insect Physiology. (Methuen's Biological Monographs), 134 pp.

A REVISION OF THE AFRICAN TELENOMINAE (PROCTOTRUPOIDEA, FAM. SCELIONIDAE)

By G. E. J. Nixon, B.A.

(Department of Entomology, British Museum (Nat. Hist.).)

(Communicated by N. D. Riley).

[Read 7th November, 1934].

With Plate V and Fourteen Text-figures.

Except where otherwise stated—and this applies chiefly to the species of *Telenomus*—the material forming the subject of this paper was obtained by Mr. Rowland E. Turner in Cape Province. The greater part of the revision, however, is based on bred series of insects placed at my disposal by Dr. Charles Ferrière of the Imperial Institute of Entomology.

As usual, the types of the several new species described become the property of the British Museum.

The Telenominae are of considerable economic importance, as they pass their larval stage as parasites in the eggs of various insects, chiefly Lepidoptera and Hemiptera.

All the species dealt with in the following pages have been examined by me; the only two species, the identity of which I have been unable to make out are evidently *Phanurus oriplanus* Kieffer and *Aholcus monticola* Kieffer.

Throughout this paper, long descriptions have been avoided deliberately; these are tiresome and since they would involve only the enumeration of details which in my opinion are of no specific value, would seem to be superfluous. Experimental breeding will doubtless lead to the splitting up of species which I regard as homogeneous, but it is probable that the readjustments required in the systematic treatment of them will depend on the use of characters very different from those which have hitherto been employed.

Preferential treatment has been given to the female sex. Tables for the identification of the males have been omitted, for various reasons. In the case of *Telenomus*, the males tend to be so much alike in external appearance that it would have been difficult to construct a workable key for them. The species are most likely to be named from bred series, and in such series the females usually greatly outnumber the males. With regard to *Microphanurus*, there is never a marked sexual dimorphism apart from the differences in antennal structure, and the antennae, at least in the African species, vary so little that no use can be made of them. But as the key to the females, with the exception of the first couplet, is based on characters common to both sexes it can be quite well used for the males.

In descriptions, the head is measured according to its greatest width and its greatest length; the latter is defined as the distance between a line at right angles to the frons and another joining the posterior margins of the head, when this is seen from above along a line perpendicular to a line between the posterior ocelli. Not much attention has been paid to colour, no detailed definition of the distribution of light or dark areas on the legs being given. Some species have predominately dark legs (this applies chiefly to *Telenomus* ; in *Microphanurus* they are usually yellowish), others have the legs predominately pale. In my opinion, this more or less sums up the uses that can be made of colour in the group of insects under consideration.

Finally, I wish to express my indebtedness to Mr. Engel Terzi for the excellent drawings of male genitalia.

Subfamily TELENOMINAE.

Key to the Genera.

1. Thorax very strongly flattened . . . . *Platytelenomus* Dodd.
   Thorax never strongly flattened . . . . 2.
2. Eyes hairy; parapsidal furrows wanting *Telenomus* Hal. (incl. *Aholcus* Kieff.)
   Eyes bare; parapsidal furrows sometimes present posteriorly . . . . 3.
3. Form narrow, markedly slender; abdomen in the ♀ with not more than 4 visible segments . . . . *Nirupama* gen. n.
   Form stout, never slender; abdomen in the ♀ with more than 4 visible segments . . . . *Microphanurus* Kieff.

Platytelenomus Dodd.

Platytelenomus hylas sp. n.

♀. Colour black; scape of the antennae and the legs, honey-yellow; funicle brownish-yellow. *Head* seen along a line perpendicular to a line between the posterior ocelli, strongly transverse, a little more than 2½ times as wide as its greatest length. Frons almost everywhere entirely smooth and shining. Vertex between the ocelli faintly and indefinitely scaly-reticulate. Antennae (fig. 12): funicle 5 slightly nearer in size to 4 than to 6 so that the club is more or less 4-segmented. Eyes hairy. *Thorax* remarkably flattened and exactly in the same plane as the abdomen. Mesonotum with close, indefinite, minute puncturation in front; in the middle this sculpture becomes sparser and on the posterior half or third it fades out completely leaving an entirely smooth surface. Scutellum entirely smooth and polished; postscutellum likewise smooth, about ½ as long as the scutellum and without any trace of a medial swelling. Lateral areas of the propodeum much flattened, smooth and shining, more or less on the same plane as the rest of the thorax. Fore-wings more or less hyaline; stigmalis rather long; postmarginalis indistinct but evidently nearly twice as long as the stigmalis; hind-wing with the fringe fully as long as the width of the wing. *Abdomen* strongly narrowed at base; tergite 2 but little less than twice as wide apically as basally, virtually unsculptured, its striations restricted to the extreme base of the segment.

♂. Antennae brownish-yellow; funicular segments 4–9 darker in colour and more or less spherical. Otherwise like the ♀. Length: ♂♀, ·8 mm. approx.

BRITISH SUDAN: Shendi (*J. W. Cowland*): large series comprising both sexes, bred, xii.1929–i.1930, from eggs of *Sesamia arctica*.

There seems to be no question that the above species is correctly placed. The only other species known is Australian. According to Dodd's description this insect differs from *hylas* in having the head presumably sculptured all over and the mesonotum entirely smooth.

Telenomus Haliday.

In dealing with *Telenomus* (s.str.) considerable difficulties have been encountered. The typical species are very closely related; they show an almost monotonous uniformity of structure and sculpturation so that my attempt to tabulate them may fall far short of the standard at which I aimed. Great pains have been taken to search for, and to assess at their true value (admittedly a fluctuating one), those characters which I believe can form a foundation for the systematic arrangement of the species.

The genus has been accepted in a wide sense and the species which I have included in it form a somewhat unnatural assemblage. This seems the safest course to take until such time as material from other parts of the world can be examined. It might then be possible to define with more accuracy species groups within the genus and where it is both convenient and justifiable, to raise some of them to generic rank.

Telenomus merges gradually into *Microphanurus*; the readiest means of separating the two genera is to determine whether hairs are present on the eyes or not. A species such as *Telenomus atys* sp. n., in which the hairs are so minute as easily to escape detection, bridges the gulf between the genera. This particular species has been included in the keys to both *Telenomus* and *Microphanurus*.

The genitalia of most of the species are figured. They seem to show good specific characters.

The following table summarises the differences between these two genera :—

Microphanurus.	*Telenomus.*
Vertex frequently with a completely differentiated ridge immediately behind the posterior ocelli or sharply angled between them.	Vertex only exceptionally with a completely differentiated ridge between the posterior ocelli, but frequently sharply angled between them; typically, the vertex is rounded at this point.
Frons in greater part, usually sculptured.	Frons in greater part usually smooth and shining.
Eyes bare.	Eyes hairy but sometimes the hairs very minute.
Mesonotum rugose, rugose-reticulate, or finely scaly-reticulate and then covered with raised points.	Mesonotum usually finely granulate, the granulations not remarkably close.
Scutellum often as strongly sculptured as the mesonotum.	Scutellum normally entirely smooth and shining.
Parapsidal furrows frequently present but only posteriorly and then short.	Parapsidal furrows always wanting.
Hind-wing always broad, the fringe always many times shorter than its greatest width.	Hind-wing often narrow, the fringe hardly less than one-half to one-third its greatest width.
Abdomen at most, but little more than 1½ times as long as wide.	Abdomen usually clearly longer than wide, often much elongated.
Apical tergites often with minute puncturation.	Apical tergites without puncturation, entirely smooth as a general rule.

Key to the Species (♀♀).

1. Antennae 10-segmented. (Spp. without a trace of a ridge between the posterior ocelli; club more or less distinctly 5-segmented) . . . . 2.
Antennae 11-segmented . . . . 4.
2. Stigmalis markedly long (pl. V); head seen along a line perpendicular to a line between the posterior ocelli twice as wide as long, 16 : 8. (Large sp., 1·5 mm.; legs markedly yellowish) . . . . 1. *cybele* sp. n.
Stigmalis of normal length (pl. V) or if rather long then the head is less transverse . . . . 3.

3. Stigmalis of normal length; head about 6 : 3. (Small sp.; size ·7 mm. approx.) . . . . 2. *brimo* sp. n.
Stigmalis rather long; head less transverse, about 11 : 7. (Larger sp.; size 1 mm. approx.) . . . . 3. *thoas* sp. n.

4. Abdomen conspicuously longer than wide, at least $2\frac{1}{2}$ times as long as its greatest width . . . . 5.
Abdomen not conspicuously longer than wide, less than $2\frac{1}{2}$ times as long as its greatest width . . . . 11.

5. Tergite 1 virtually without longitudinal striations, or, at the most, with them restricted to an indistinct punctured line along the basal margin of the segment. (Sp. with the hind-wing very narrow, its fringe hardly shorter than its greatest width) . . . . 6.
Tergite 1 with the normal striations . . . . 7.

6. Tergite 1 strongly transverse, at least 3 times as wide apically as long medially, without any trace of a basal swelling, that is, without the beginnings of a horn. (Spp. with the head about twice as wide as long, 8 : 4; abdomen about 3 times as long as wide) . . . 17. *nephele* sp. n.
Tergite 1 by no means strongly transverse, at least slightly, usually quite strongly, swollen over its more basal part, so that seen from the side, it is feebly or markedly produced forwards in the direction of the propodeum to form a blunt, polished horn. (Sp. with the head more or less subcubical, about 11 : 7; eyes large; abdomen variable in length but usually about 3 times as long as wide, 24 : 7) . . 16. *benefactor* Craw.

7. Head dull, its sculpture very characteristic, covered everywhere with tiny raised points which on the frons are as close together as possible; mesonotum sculptured like the head, densely and very conspicuously clothed with tiny, silvery, adpressed, glistening hairs. (Sp. with the wings extending beyond the apex of the abdomen) . . 18. *pylades* sp. n.
Head without such sculpture; if granulations are present, they are not close and are superimposed on a fine scaly-reticulate sculpture and the apex of the abdomen extends beyond the wings; mesonotum clothed only with the usual fine, brownish hairs . . . . 8.

8. Abdomen greatly attenuated, widest (in most examples) far proximal to the middle, about 4–5 times as long as its greatest width 20. *gowdeyi* Craw.
Abdomen not greatly attenuated, widest in the middle, more or less. (Spp. with the head less than twice as wide as its greatest length; no trace of a ridge between the posterior ocelli) . . . . 9.

9. Posterior (declivous) part of the vertex conspicuously granulate; abdomen markedly flattened above. (Sp. with the hind-wings widest in about the apical third) . . . . 19. *iphias* sp. n.
Posterior part of the vertex not conspicuously granulate; abdomen not markedly flattened above . . . . 10.

10. Frons in greater part smooth and shining . . . . . 14. *pyramus* sp. n.
Frons dull, very closely scaly-reticulate . . . . . . 13. *tityrus* sp. n.

11. Frons almost everywhere (even in front of the anterior ocellus) dull and sculptured, the sculpture very closely scaly-reticulate, almost finely rugose; only immediately above the antennal insertions does the sculpture tend to fade out. (Stout, dumpy sp. with the head strongly transverse and wider than the thorax; the hairs on the eyes are extremely short and not readily visible). . . . . 15. *atys* sp. n.
Frons extensively smooth, shining and polished, at least in front of the anterior ocellus; generally it is in greater part entirely smooth; whatever sculpture there is, is usually faint and narrowly restricted to the inner margin of the eye, or if it shows as a broad band along the inner margin of the eye, there is no trace of a ridge between the posterior ocelli . . . . 12.

12. Radicle of the antennae more than one-third the length of the scape. (Sp. with the vertex sharply and completely margined behind; frons with a conspicuous bulge on each side between the mouth and the lower, inner margin of the eye) . . . . 11. *codrus* sp. n.
    Radicle considerably or much less than one-third the length of the scape . . . . 13.
13. Stigmalis rather long (pl. V) . . . . 14.
    Stigmalis short (pl. V). (Spp. with the wings faintly smoky; head more than twice as wide as its greatest length, markedly wider than the thorax; size, ·5–·6 mm.) . . . . 18.
14. Head hardly twice as wide as its greatest length, about 9 : 5 or less. (Spp. with no trace of a ridge between the posterior ocelli; funicle 5 more or less intermediate in size between 4 and 6, so that the limits of the club are not clearly defined) . . . . 15.
    Head distinctly more than twice as wide as its greatest length . . . 16.
15. Scape black almost entirely; when the head is seen from above, there is a conspicuous notch between the posterior margin of the eye and the raised margin bordering it. (Very dark sp. with blackish legs; mesonotum somewhat depressed along the middle) . . . . 10. *pylus* sp. n.
    Scape more or less transparent yellow or brownish-yellow; when the head is seen from above, there is only a feeble notch between the posterior margin of the eye and the raised margin bordering it. (Sp. with the legs of the same colour as the scape; mesonotum evenly convex) . . . . 9. *aleus* sp. n.
16. Funicle 5 more or less intermediate in size between 4 and 6 so that the limits of the club are not clearly defined. (Fairly large sp., 1 mm.; legs pale transparent yellow; vertex very sharply angled between the posterior ocelli) . . . . 12. *sciron* sp. n.
    Funicle 5 much nearer in size to 6 than to 4 so that the club is very distinctly 5-segmented . . . . 17.
17. Tergite 2 not obviously longer than wide; length ·9 mm. . 8. *hyperion* sp. n.
    Tergite 2 very distinctly longer than wide; length, 1·4 mm. 7. *numitor* sp. n.
18. Head more than twice as wide as its greatest length, markedly wider than the thorax . . . . 5. *thestor* and 4. *procas* spp. n.
    Head less than twice as wide as its greatest length, subcubical, 5 : 3; size : ·6 mm. approx. . . . . 6. *polycrates* sp. n.

The following three species fall within the genus *Aholcus* Kieffer according to Kieffer's table of genera. This is on account of the females possessing 10 segments to the antennae. Apart from this character the species are very typical of the genus *Telenomus* and the males would certainly have to be placed within this genus. I am of the opinion that the genus *Aholcus* is inconveniently artificial and that its maintenance can serve only to clutter the already overcrowded nomenclature of the Proctotrupoidea. In this paper, therefore, I propose to sink it as a synonym of *Telenomus*.

(1) **Telenomus cybele** sp. n.

♀. Black. Scape blackish-brown but markedly paler at base and apex. Legs entirely honey-yellow. *Head* seen from above along a line perpendicular to a line between the posterior ocelli, a little more than twice as wide as its greatest length, 11 : 5. Frons evenly convex, smooth and shining up to the anterior ocellus. Vertex between the ocelli, dull and very clearly scaly-reticulate; a few ill-defined punctures occur here and a short row of some six sharply defined punctures extends from the sculptured surface midway between the anterior and posterior ocellus and extends down the frons along the inner eye-margin, very close to the eye and to about its mid-point. Cheeks with a well-marked genal depression situated close to the mouth. Eyes rather large, the shortest distance between them a little greater than their width, as seen from above. Margin bordering the eyes behind, and the surface between it and the occipital margin forming virtually a straight edge when the head is seen from above. Antennae (fig. 3): funicle 1 nearly twice as long as its greatest width; 3 nearer in size to 2 than to 4, so that the club is 5-segmented. Temples more or less smooth and shining. *Thorax*: mesonotum somewhat dull, extremely finely and closely scaly-reticulate, with very small, very ill-defined punctures, which are fairly close together. Scutellum virtually smooth and shining. Fore-wings yellowish, the stigmalis long (pl. V). *Abdomen*: tergite 2 distinctly longer than wide; abdomen otherwise typical.

♂. Antennae a little longer than the head and the thorax together; funicle blackish; funicle 4 about 1½ times as long as wide. Genitalia rather heavily chitinised everywhere (fig. 4). Length: ♂♀, 1·5 mm. approx.

UGANDA: Kampala (*H. Hargreaves*): series of 20 ♀♀, 3 ♂♂, bred from eggs of a Saturniid.

(2) **Telenomus brimo** sp. n.

Species differing from the preceding as follows:—

Antennal scape entirely blackish. Legs in greater part blackish. Mesonotum more shining, its sculpture more vague. Genal depression feeble. Fore-wings more or less hyaline with a smoky tinge; stigmalis short, its swollen apex somewhat indistinct (pl. V).

♂. Genitalia very different from those of *cybele* (fig. 4).

UGANDA: Kingala (*H. Hargreaves*): 2 ♀♀, 2 ♂♂, bred from eggs of *Herse convolvuli*.

(3) **Telenomus thoas** sp. n.

A species intermediate in size between *cybele* and *brimo* and not readily distinguished from either of them. The genitalia of the male correspond more to those of *cybele* than to those of *brimo*.

♀. *Head* a little less transverse than in *cybele* and *brimo*, seen along a line perpendicular to a line between the posterior ocelli less than twice as wide as long, 11 : 6. Vertex slightly less sharply rounded than in either of the two preceding species, its surface between the ocelli more shining than in *cybele* and less definitely scaly-reticulate; in front of the ocelli the surface appears merely roughened. Antennae (fig. 3) coloured as in *brimo*. Genal depression not so well defined as in *cybele* but stronger than in *brimo*. *Thorax*: Mesonotum slightly more shining than in *cybele* but the sculpture closer and less definite, although not vague as in *brimo*. Fore-wings coloured as in *brimo*; the stigmalis intermediate in length between the two other species; the thickened part of the stigmalis is not ill-defined as in *brimo*. Legs coloured as in *brimo*. ♂ genitalia (fig. 4). Length: 1 mm. approx.

GOLD COAST: Aburi (*W. H. Patterson*): very large series, mostly ♀♀, bred 15.xi.1921, from (presumably?) eggs of *Pyrrhochalcia iphis* Drury. The host is a pest of coconut and other palms.

The only sure means of distinguishing this species is by an examination of the male genitalia. The description given above will be almost valueless unless one at least of the two other species is available for comparison.

(4) **Telenomus procas** sp. n.

A very small species, ·6 mm. in length and chiefly characterised as follows:—

♀. *Head* strongly transverse, its width to its greatest length about 13 : 6, markedly wider than the thorax. Vertex rather sharply angled between the anterior ocellus and the occipital margin. Antennae entirely blackish. Legs dark, obscurely brownish. Antennal club more or less 5-segmented; funicle 1, 2 and 3 subequal and more or less spherical. *Thorax*: fore-wings with the venation pale; stigmalis short (fig. 1). *Abdomen*: tergite 1 striated all over, that is, except for the narrow, smooth apical margin which is common to all the species of the genus.

♂. Hardly distinguishable from that of *thestor* sp. n. except in size. The genitalia (fig. 1) show the two species to be very distinct from each other, however.

British Sudan: Wad Medani (*H. B. Johnston*): two series comprising 10 ♀♀, 7 ♂♂, bred 24.xi.1927 and 29.xii.1927 from eggs of *Deiopeia pulchella*, a pest of *Cajanus indicus*.

T. procas could be confused only with the following species. From *hyperion* sp. n. it differs in having the antennal club less distinctly 5-segmented and the stigmalis markedly shorter.

(5) **Telenomus thestor** sp. n.

This species does not appear to be distinguishable from *procas* in the female sex. The male, however, has entirely different genitalia from *procas* (fig. 1), and there are slight differences in the antennae; these are slightly shorter, darker in colour and segments 5–9 are distinctly transverse whereas in *procas* they are a little longer than wide. Antennae ♀ (fig. 3), wing ♀ (pl. V).

Uganda: Kampala (*H. Hargreaves*): large series, comprising both sexes, bred 16.vi.1930, from Lepidopterous eggs on "Mukasa"; Bukalasa (*H. Hargreaves*): series of 5 ♀♀, 1 ♂, bred ii.1932, from Lycaenid eggs, ? *Spalgis lemolea* (*H. H. Druce*), on coffee berries.

(6) **Telenomus polycrates** sp. n.

A very small species of the size of *procas*, from which it differs as follows :—

♀. *Head* much less transverse, almost subcubical, its width to its greatest length as 5 : 3. Vertex evenly rounded between the anterior ocellus and the occipital margin. Frons sometimes with a feeble furrow extending from the antennal insertion to the anterior ocellus. Antennae shorter, the club feebly 4-segmented. *Abdomen*: tergite 1 usually not striated beyond the middle, and the apical margin somewhat swollen. It should be born in mind that these two characters are difficult to appreciate and by no means reliable.

♂. Antennae shorter, stouter, all the segments of the funicle more or less spherical or the more apical ones slightly transverse and in this respect differing from *procas*, in which species the funicular segments tend to be slightly longer than wide. Genitalia (fig. 1).

British Sudan: Wad Medani (*H. B. Johnston*): series of 11 ♀♀, 1 ♂, bred 24.xi.1927 from eggs of *Deiopeia pulchella* on *Cajanus indicus*. This series was evidently bred together with one of the series of *procas*.

The shape of the head will immediately separate this species from *procas*. It is the only character which really holds for the separation of the females of the two species.

(7) **Telenomus numitor** sp. n.

♀. Colour black. Scape blackish, but reddish towards the base. Tibiae and tarsi bright brownish-red; femora darker. *Head* strongly transverse, seen from above along a line perpendicular to a line between the posterior ocelli, with its width to its greatest length, about 9 : 4 (fig. 2). Frons nearly everywhere entirely smooth and shining. Vertex between the ocelli, and frons between the antennal insertions and the lower margin of the eye, finely and clearly scaly-reticulate. Margin bordering the eyes behind, well raised; the head behind this margin is very sharply narrowed; the edge between the postorbital margin and the occipital margin, as seen from above, straight. The vertex behind the posterior ocelli slopes almost perpendicularly away to the occipital margin. Eyes very distinctly hairy; shortest distance between them much shorter than their width. Antennae (fig. 3): funicle 1 nearly twice as long as wide; 3 and 4 subequal, more or less spherical; 4 much nearer in size to 3 than to 5, so that the club is very distinctly 5-segmented. Genal sulcus wide and gaping. *Thorax* less wide than the head. Mesonotum somewhat shining, very finely granulate, the sculpture typical of *Telenomus*. Wings yellowish with the venation sharply defined, especially the marginalis and the stigmalis, which are a rich

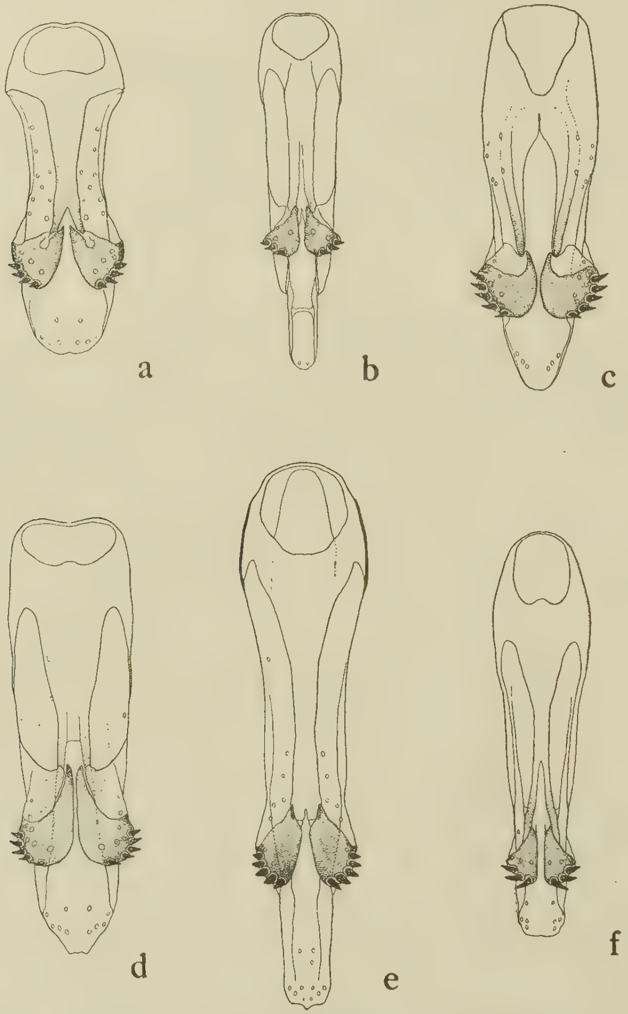


Fig. 1.—Male genitalia of a, *Telenomus thestor* sp. n.; b, *T. procas* sp. n.; c, *T. polycrates* sp. n.; d, *T. aleus* sp. n.; e, *T. numitor* sp. n.; f, *T. hyperion* sp. n.

brown; the latter is long; postmarginalis about one and one-third as long as the stigmalis (pl. V). *Abdomen* about 1½ times as long as wide, 14 : 9. Tergite 2 distinctly longer than wide. Length: ♂♀, 1·4–1·5 mm.

♂. Funicle blackish; funicle 2 a very little longer than 1, markedly cylindrical, fully 2½ times as long as wide; 3 a little curved and produced beneath near the apex; 5–9 spherical. Genitalia (fig. 1).

CAPE PROVINCE: Dohne, 7 ♀♀, 8 ♂♂, bred xii.1921 from eggs of *Gonimbrasia tyrrhea.*

This species is chiefly characterised by its large size, shape of the head and very distinctly 5-segmented antennal club in the female.

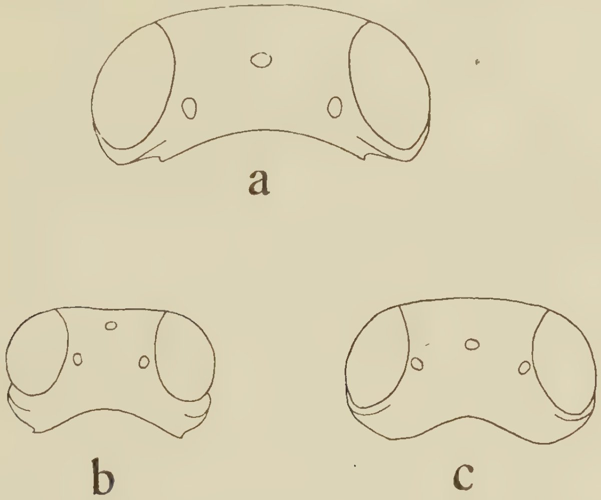


FIG. 2.—Head (from above) of a, *Telenomus numitor* sp. n.; b, *T. pylus* sp. n.; c, *T. aleus*, sp. n.

(8) **Telenomus hyperion** sp. n.

Species extremely like *numitor*, but much smaller. It differs from that species as follows:—

♀. Colour: legs darker, the tibiae and the tarsi less brightly coloured. Scape of the antennae more or less black, without the conspicuous reddish base of *numitor*, although the extreme base is pale. *Head* larger in proportion to the size of the thorax, and conspicuously wider than this. Antennae: funicle 1 hardly longer than wide; 2 and 3 almost spherical. *Thorax*: mesonotum more finely sculptured, the granulations less distinct. Fore-wings greyish with the venation less sharply defined, the veins pale testaceous. *Abdomen*: tergite 2 not obviously longer than wide.

♂. Funicle not so dark, yellowish-brown; funicle 2 hardly twice as long as wide. Genitalia (fig. 1). Length: ♂♀, ·9 mm. approx.

SUDAN: Khartoum (*H. W. Bedford*): series of 9 ♀♀, 2 ♂♂, bred 16.iii.1931, from eggs of *Anadiasa obsoleta.*

(9) **Telenomus aleus** sp. n.

This species may be compared with *hyperion* as follows:—

♀. Colour: scape of the antennae more or less yellow entirely. Legs except the coxae, pale brownish-yellow. *Head* less transverse, about 9 : 5, when seen along a line perpendicular to a line between the posterior ocelli (fig. 2). Frons smooth and shining immediately above the antennal insertions, and this smooth surface extends as a narrow band up to the anterior ocellus. Vertex somewhat dull, very clearly scaly-reticulate, this sculpture extending as a broad band down the frons along the eye-margins; further, the vertex is evenly rounded between the anterior ocellus and the occipital margin. There are a few scattered but not sharply defined punctures along the inner eye-margin above. Antennae (fig. 3) much more slender, club not so thick; funicle 1 nearly twice as long as wide; 4 intermediate in size between 5 and 3 so that the club is not clearly 5-segmented. *Thorax* a little less shining. The scaly-reticulate ground-sculpture of the mesonotum

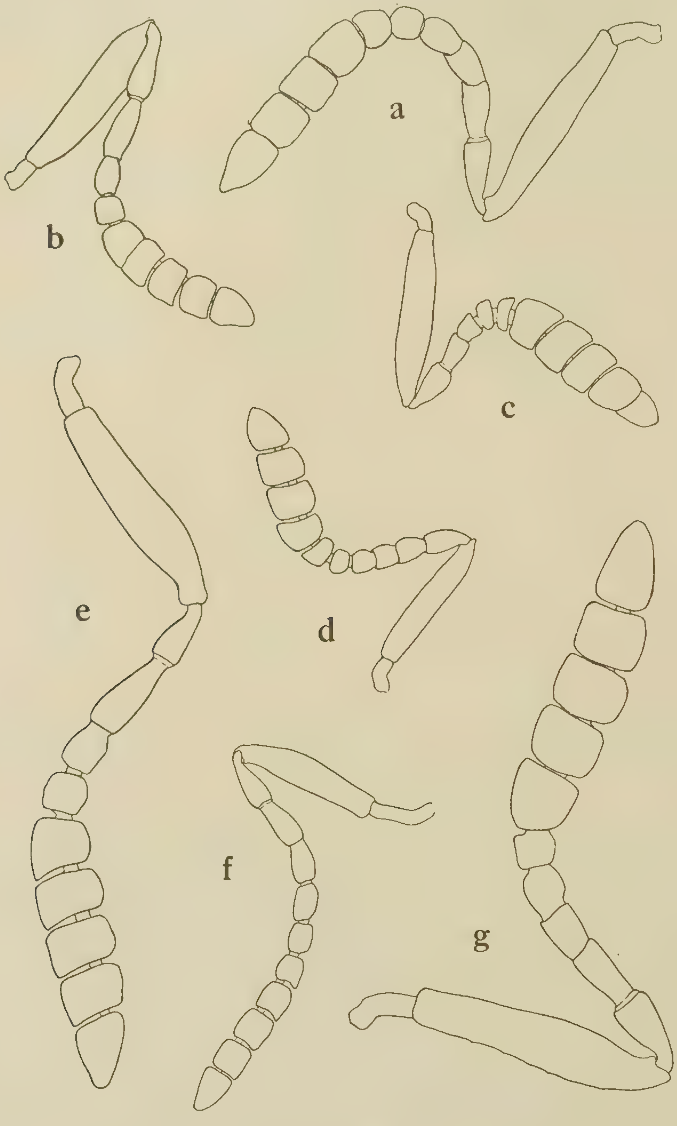


Fig. 3.—Female antenna of a, *Telenomus aleus* sp. n.; b, *T. thoas* sp. n.; c, *T. atys* sp. n.; d, *T. thestor* sp. n.; e, *T. cybele* sp. n.; f, *T. codrus* sp. n.; g, *T. numitor* sp. n.

more in evidence, extremely close and fine; there is hardly any indication of granulations. Wings not distinguishable from those of *hyperion.*

♂. Antennae hardly distinguishable from those of *numitor.* Genitalia (fig. 1). Length: ♂♀, 1·1–1·2 mm.

UGANDA: Kampala (*H. Hargreaves*): series of 26 ♀♀, 3 ♂♂, bred from eggs of a Notodontid, 29.viii.1929.

(10) **Telenomus pylus** sp. n.

♀. Colour black. Antennae, including scape, entirely black. *Head* not twice as wide as its greatest length, seen along a line perpendicular to a line between the posterior ocelli, about 15 : 9 (fig. 2). There is a very distinct groove between the posterior margin of the eyes and the raised margin bordering them; this appears as a notch when the head is seen from above. Frons with a fairly deep impression and in greater part entirely smooth and shining. Along the inner eye-margin there is some indication of microscopic sculpturation. Vertex between the ocelli vaguely scaly-reticulate; on the posterior part of the vertex the surface is more shining but quite indefinitely sculptured. Eyes large, the shortest distance between them (across the anterior ocellus) about equal to their width as seen from above. There is no trace of a ridge or angulation of vertex between the posterior ocelli. Antennae: funicle 1, 1½ times as long as wide; 3 and 4 more or less spherical; 6 nearer in length to 7 than to 5 but 5 more or less intermediate in size between 4 and 6 so that the club is not clearly defined. *Thorax*: mesonotum somewhat depressed along the middle, feebly shining and very finely granulate. Scutellum more or less entirely smooth and shining. *Abdomen* about 1¼ times as long as wide.

♂. Head more transverse than in the ♀, about 4 : 2. Antennae: funicle 2 a little more than twice as long as wide and a little longer than 1; 5–9 all a little longer than wide. Genitalia (fig. 4). Length: ♂♀, 1·1 mm. approx.

CAPE PROVINCE: Mossel Bay, vi.–viii., 9 ♀♀; v., 2 ♂♂ (Somerset East), xii., 1 ♂.

This species is characterised largely by the shape of the head and by the well-marked groove behind the eyes; this latter feature is not so noticeable in the males.

(11) **Telenomus codrus** sp. n.

This species is chiefly characterised as follows:—

♀. Colour: legs pale yellowish-brown. *Head* a little wider than the thorax. Carina bordering the eyes behind continued as a sharp, more or less smooth but not always completely differentiated ridge across the vertex. When the head is seen from above along a line perpendicular to the anterior ocellus, its width to its greatest length is as 7 : 4. When the head is thus seen, there is, further, a conspicuous bulge on each side of the frons between the antennal insertion and the lower margin of the eye. The entire frons and vertex in front of the margin, virtually smooth and shining. Antennae (fig. 3): long and somewhat slender; radicle more than one-third the length of the scape; funicle 2 about 1½ times as long as wide; the club is not very thick nor is it clearly differentiated. *Thorax*: mesonotum somewhat shining, with an extremely fine, vague sculpture and without distinct granulations. Scutellum smooth and shining. Two hind pairs of legs with the femora unusually strongly compressed laterally. Fore-wings greyish, extending far beyond the apex of the abdomen. *Abdomen* about twice as long as wide, considerably narrower than the thorax. Tergite 2 distinctly longer than wide.

♂. Antennae entirely pale brownish-yellow; radicle as in the ♀; segments 4–9 of the funicle more or less spherical. Genitalia (fig. 4). Length: ♂♀, ·8 mm. approx.

UGANDA: Kampala (*H. Hargreaves*): series of 4 ♀♀, 4 ♂♂, bred 16.vii.1927 from yellow Lepidopterous eggs on leaf of *Erythrina* sp.

With regard to the frontal bulges and complete vertical margin, this species is like certain species of *Microphanurus* such as *seychellensis* Kieffer. The same characters (more especially the vertical margin) and long radicle of the antennae will separate it from the other species of *Telenomus* described in this paper.

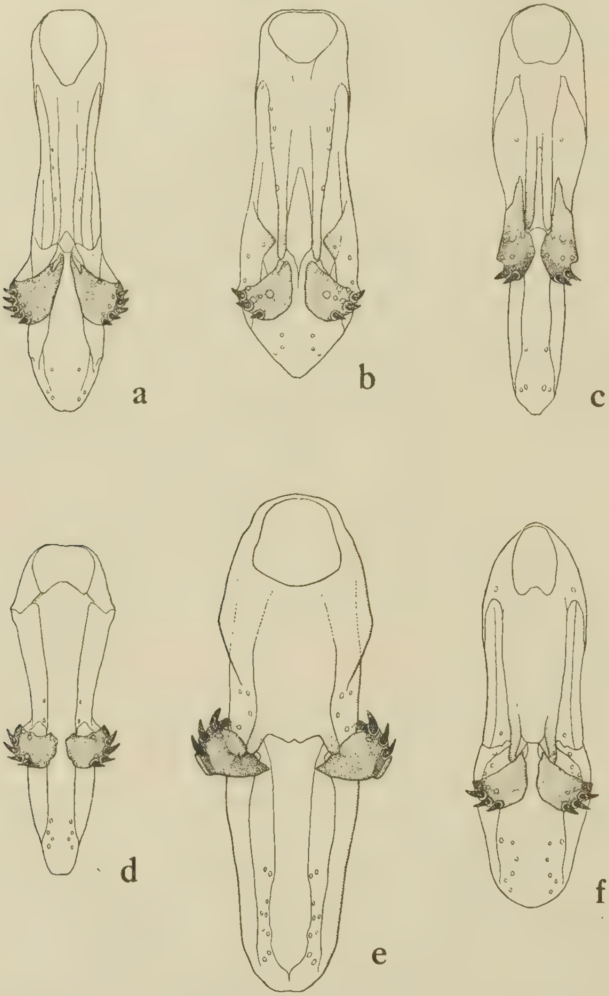


FIG. 4.—Male genitalia of a, *Telenomus codrus* sp. n.; b, *T. pylus* sp. n.; c, *T. sciron* sp. n.; d, *T. brimo* sp. n.; e, *T. cybele* sp. n.; f, *T. thoas* sp. n.

(12) **Telenomus sciron** sp. n.

In general facies this species closely resembles *codrus*, with which it may be compared as follows:—

♂♀. *Head*: Frons without conspicuous bulges between the antennal insertions and the lower margin of the eye. Head somewhat flattened across the region of the anterior ocellus. Vertex very sharply angled between the posterior ocelli, but there is no clear indication here of a sharply defined smooth ridge; the narrow strip of vertex between the angulation and the anterior ocellus is scaly-reticulate, with posteriorly the surface somewhat roughened. Antennae: radicle many times shorter than the scape. *Thorax*: mesonotum somewhat less shining than in *codrus*. *Abdomen* wider in proportion to the width of the thorax than in *codrus*. ♂ genitalia (fig. 4). Length: ♂♀, 1 mm. approx.

UGANDA: series of 7 ♂♂, 4 ♀♀, bred from eggs of *Crotolaria* sp.; NATAL: Howick (*J. P. Cregoe*): series of 14 ♀♀ bred from eggs of *Callioratis bellatrix*.

(13) **Telenomus tityrus** sp. n.

This is a fairly large species of elongate form.

♀. Colour: scape of the antennae and legs reddish-yellow. Pedicel and first 4 segments of the funicle a little less brightly coloured than the scape. *Head* thickly hairy and when seen along a line perpendicular to a line between the ocelli, less than twice as wide as its greatest length, about 5 : 3 (fig. 5); it is dull almost everywhere, even in front of the anterior ocellus, being very finely and closely scaly-reticulate. No narrowing whatever of the vertex between the anterior ocellus and the occipital margin; posterior part of the vertex slightly duller than the frons. Eyes large, the hairs hardly visible and very sparse; shortest distance between the eyes (on the frons) about equal to the length of the eye itself. Antennae: funicular segments closely articulated, and in this respect the funicle resembles the type seen in *Microphanurus*; funicle 1 fully twice as long as its apical width; 2 and 3 slightly transverse and together hardly longer than 1; 5 much nearer in length to 6 than to 4 so that if the length of the segments alone is considered, the club consists of 5 black segments; 4 strongly transverse, intermediate in width between 3 and 5. *Thorax* clothed with semi-erect, brownish hairs. Mesonotum somewhat shining, not dull like the head, covered with distinct granulations. Scutellum finely scaly-reticulate, without distinct granulations. Fore-wings markedly brownish, extending a little beyond the apex of the abdomen. *Abdomen* sharply pointed at apex; tergite 2 a very little longer than wide, its striae fairly strong and extending beyond the middle of the segment; tergites 3–5 with microscopic punctures at base and each with an ill-defined row of larger ones among these punctures. Abdomen beyond apex of 4 forming a triangle the base of which is a little shorter than its sides. Length: 1·5 mm.

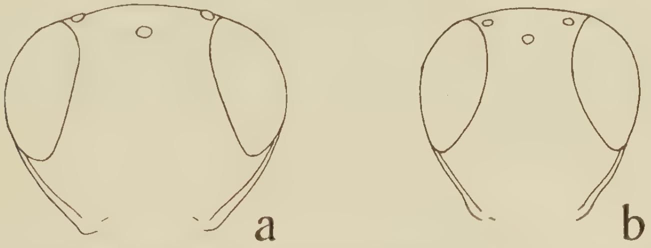


FIG. 5.—Head (from in front) of a, *Telenomus tityrus* sp. n.; b, *T. pyramus* sp. n.

CAPE PROVINCE: Port St. John, –.vi., 1 ♀.

The dull sculptured head of this species, the apparent absence of hairs on the eyes and the well-marked striae of tergite 2 suggest that it were better placed in *Microphanurus*. However, the by no means strongly transverse head, the evenly rounded vertex, sculpture of mesonotum and general facies, show the insect to have a more natural affinity with *Telenomus*.

(14) **Telenomus pyramus** sp. n.

In general appearance very like the preceding species from which it differs as follows :—

♀. Funicle entirely black. *Head* seen along a line perpendicular to a line between the posterior ocelli, with its width to its greatest length as 8 : 5 (fig. 5). When thus seen, there is a distinct notch between the eye behind and the raised margin bordering it (cf. fig. 2, *pylus*); this notch is not apparent in *tityrus*. Frons in greater part entirely smooth and shining. Posterior (declivous) part of the vertex, although finely and closely scaly-reticulate, fairly smooth and slightly shining. Antennae : more slender than in *tityrus*; funicle 1 more than twice as long as wide; funicle 3 about 1½ times as long as wide; 4 about as long as wide; club feebly 5-segmented. Eyes larger than in *tityrus*, distinctly hairy, closer together on the frons, where the shortest distance between them is hardly two-thirds the width of the eye. *Abdomen* a little longer, about 16 : 7; tergite 2 very distinctly longer than wide; 3 and 4 with microscopic sculpturation but not clear puncturation.

Cape Province : Port St. John, –.vi., 1 ♀.

(15) **Telenomus atys** sp. n.

A stout, dumpy species of very compact build, reminiscent of *Microphanurus*. The hairs on the eyes, on the strength of which feature the species has been placed in *Telenomus*, are by no means conspicuous and so, for the sake of convenience, the species has been included also in the key to *Microphanurus* with which genus it has perhaps a more natural affinity.

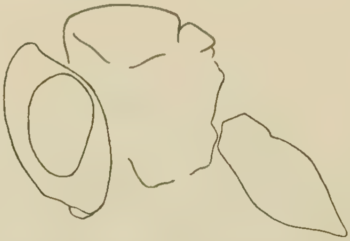


Fig. 6.—*Telenomus atys* sp. n., ♀ (head not quite lateral).

♀. Colour : scape, pedicel and first four segments of the funicle and the legs, more or less yellow-testaceous. *Head* strongly transverse, seen along a line perpendicular to a line between the posterior ocelli about 2½ times as wide as long, 8 : 3. Frons dull, almost everywhere—even immediately in front of the anterior ocellus—very closely scaly-reticulate, almost finely rugose. Vertex sharply angled between the posterior ocelli but not showing a completely differentiated ridge. Eyes rather wide apart, the shortest distance between them, on the frons, more than 1½ times as great as their width, as seen from above. Antennae typical of *Microphanurus* (fig. 3) : funicular segments 1–4 together about half as long as 5–9 together; 4 strongly transverse, club very thick, its segments closely set, consisting more or less of 6 segments of which the first is the yellow, transverse funicular 4. *Thorax* a little narrower than the head, strongly raised above the level of the abdomen. Mesonotum delicately and somewhat vaguely reticulated; posteriorly the reticulations develop into fine longitudinal ridges. Scutellum very finely rugose. Postscutellum slightly raised medially, the raised part wide and longitudinally costate; there is no clearly marked central rugose swelling. Fore-wings nearly hyaline; venation pale; stigmalis long; postmarginalis nearly twice as long as the stigmalis; hind-wings (fig. 10). Legs slender. *Abdomen* as long as wide; tergite 2 strongly transverse, very indistinctly and superficially striated on its basal half.

♂. Differs from the ♀ only in the antennae; these are somewhat slender; scape pedicel and first 5 segments of the funicle yellow; remaining funicular segments infuscated. Genitalia (fig. 8). Length: ♂♀, ·7 mm. approx.

UGANDA: Kampala (*H. Hargreaves*): series of 9 ♀♀, 3 ♂♂, bred ix.1930 from eggs of *Phyrodocus lystrix* Germ.

This species is chiefly characterised by the strongly transverse head, and sculpture of frons and of mesonotum. It should be noted that, with regard to the sculpture of the mesonotum, it differs from all the other species of *Telenomus* described in this paper.

(16) *Telenomus benefactor* Crawford.

1911, *Proc. U.S. nat. Mus.*, **40**: 439, ♂♀.
Microphanurus benefactor Kieffer, 1926, *Das Tierreich*, **48**: 103.

♀. Colour: antennal scape in greater part blackish. Legs brownish, the femora infuscated. *Head* not quite twice as wide as its greatest length, about 9 : 5, appearing much less transverse than in most other species of the genus (fig. 7). Frons above the antennal insertions with a feeble ill-defined impression; frons almost everywhere entirely smooth and shining; against the eye-margin there is some indication of fine sculpturation. Vertex above, very feebly scaly-reticulate, with some indication of minute, ill-defined punctures. Eyes rather large, apparently bare, the shortest distance between them

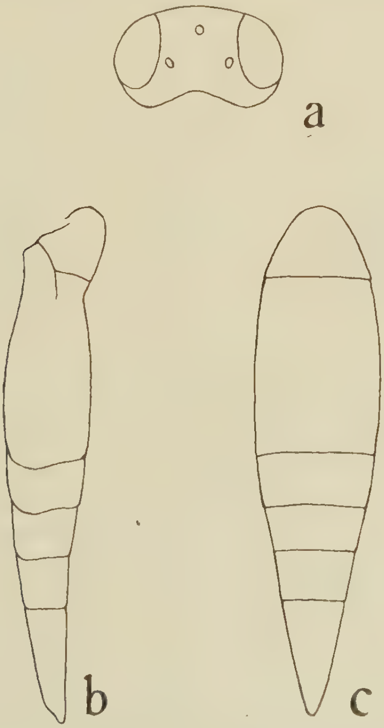


FIG. 7.—*Telenomus benefactor* Crawford, ♀; a, head, from above; b, abdomen, lateral; c, abdomen, dorsal.

about equal to their width. Antennae typical of *Telenomus*, somewhat stout; club more or less 5-segmented. *Thorax*: mesonotum somewhat dull, with the same feeble and indefinite sculpture which appears on the vertex, but with a clearer indication of punctures. Fore-wings faintly smoky, not reaching the apex of the abdomen, the venation not sharply defined; stigmalis short, ill defined; hind-wings narrow, their fringe a little shorter than in following species, about $\frac{2}{3}$ to $\frac{3}{4}$ the greatest width of the wing (fig. 10). Legs slender. *Abdomen* variable in length, usually widest in front of the middle, thence tapering gradually to a point (fig. 7). Tergite 1 virtually without sculpture, smooth and shining—only at the basal lateral corners is there some trace of sculpturation. The apical tergites show traces of microscopic sculpturation. A greater length of the abdomen appears to be correlated with a more pronounced development of the horn of the first tergite. Length: 1·1–1·2 mm. approx.

♂. Remarkably unlike the ♀ in certain respects. Unless bred series had been available for study, I should not have associated the two sexes. *Head* yellowish-brown, becoming much paler towards the mouth, or entirely pale all over. Scape of the antennae and legs, entirely yellow (except the apical segment of the tarsi), approaching ochreous yellow and opaque. Funicle more or less blackish. Sculpture of the head like that of the ♀. Eyes not so large as in the ♀. Funicle of the antennae very short, segments 1–3 but little longer than wide; 4–9 more or less transverse. *Thorax*: legs, especially the two front pairs, short and stout, the femora and tibiae strongly thickened. *Abdomen* nearly twice as long as wide. Tergite 1 transverse, somewhat swollen, sometimes nearly smooth, but usually with indications of striations at the base, or at least towards the sides of the base. Genitalia (fig. 8). Length: ·9 mm. approx.

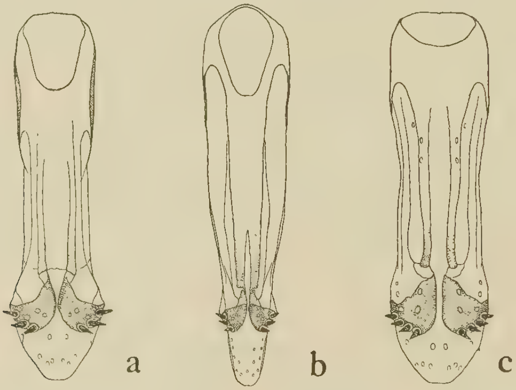


Fig. 8.—Male genitalia of a, *Telenomus atys* sp. n.; b, *T. benefactor* Craw.; c, *T. pylades* sp. n.

SUDAN: Gebelein, Type series from eggs of *Tabanus taeniola* P. de B.; NYASALAND: Fort Johnston and Maiwalo (*W. A. Lamborn*): numerous examples, mostly females, bred from the ootheca of *Tabanus biguttatus*.

This species is very distinct in the ♀ on account of the length of the abdomen and form and sculpture of the 1st tergite. The ♂ may be known by its pale marked head and stout legs.

(17) **Telenomus nephele** sp. n.

This species shows a close relationship to *benefactor* Crawford, but in the female sex, at least, is very distinct from that species, with which it may be compared as follows:—

♀. Colour as in *benefactor* except that the legs tend to be more yellowish. *Head* more transverse, about 33 : 16, without the subcubical appearance characteristic of *benefactor*. Sculpture of the head similar. Eyes less large, distinctly hairy, the shortest distance between them distinctly greater than their width. Antennal club more or less 4-segmented. *Thorax*: mesonotal sculpture more definite than in *benefactor*, the minute punctures more numerous. Fore-wings extending beyond the apex of the abdomen. Hind-wings narrow (fig. 10); fringe hardly shorter than greatest width of the wing. *Abdomen* narrower than the thorax. Tergite 1, as in *benefactor*, without obvious striations; at the most, with a row of punctures (effect produced by extremely short longitudinal ridges) at extreme base of the segment; tergite 2 much longer in proportion to the remaining tergites together than in *benefactor*. Apical segments without a distinct trace of microscopic sculpturation.

♂. Not differing from the ♀ to the same degree as the ♂ of *benefactor* differs from its ♀.

The ♂ of *nephele* differs from that of *benefactor* as follows :—

Form a little less elongate. Head black like the rest of the body, considerably more transverse than in *benefactor*. Funicle pale yellowish. *Thorax* above more densely hairy and more transverse. Legs not much thicker than those of the ♀ and not so unusually thickened as in the ♂ of *benefactor*. Length : ♂♀, ·7 mm. approx.

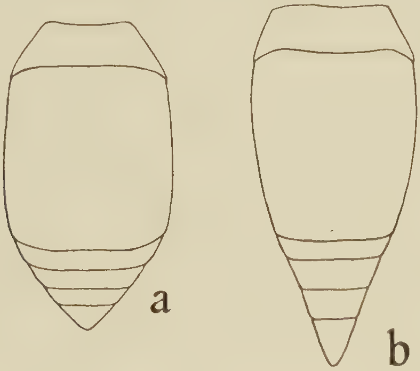


FIG. 9.—Female abdomen (dorsal view) of a, *Telenomus pylades* sp. n.; b, *T. iphias* sp. n.

NYASALAND : Maiwalo (*W. A. Lamborn*) : series 5 ♀♀, 2 ♂♂, from ? lepidopterous eggs on grass.

(18) **Telenomus pylades** sp. n.

♀. Colour : black; scape of the antennae and the legs pale yellowish; funicle entirely pale brownish-yellow. *Head* seen from above along a line perpendicular to a line between the posterior ocelli a little more than 1½ times as wide as its greatest length, about 14 : 9. Temples somewhat produced backwards so that the posterior part of the vertex appears flattened and is not at all markedly declivous. In this respect, the head resembles that of, say, a typical *Macroteleiea*. Frons above the antennal insertions with a feeble impression which is transversely aciculated. Frons in front of the ocelli and the vertex between the ocelli, densely granulated, the granulations unusually strong and as close together as possible. The posterior part of the vertex is clothed with tiny whitish hairs and is also conspicuously granulate, but not so closely as elsewhere. Eyes large and conspicuously hairy. Antennae : funicle 1 about 1½ times as long as wide; 2 and 3 spherical; club feebly 5-segmented (fig. 12). *Thorax* : mesonotum densely and evenly granulate, the granulations strong; the mesonotum, further, appears conspicuously silvery owing to its dense clothing of minute, whitish, adpressed hairs. Scutellum sculptured and clothed more or less like the mesonotum. Fore-wings somewhat whitish, extending well beyond the apex of the abdomen; hind-wings widest at about the apical third (fig. 10). *Abdomen* about twice as long as wide, markedly flattened above (fig. 9); tergite 1 longitudinally striated all over; 2 distinctly longer than wide, finely and somewhat indefinitely striated over its basal third, the striae longest at the sides and in the middle; 3, 4 and 5 subequal in length.

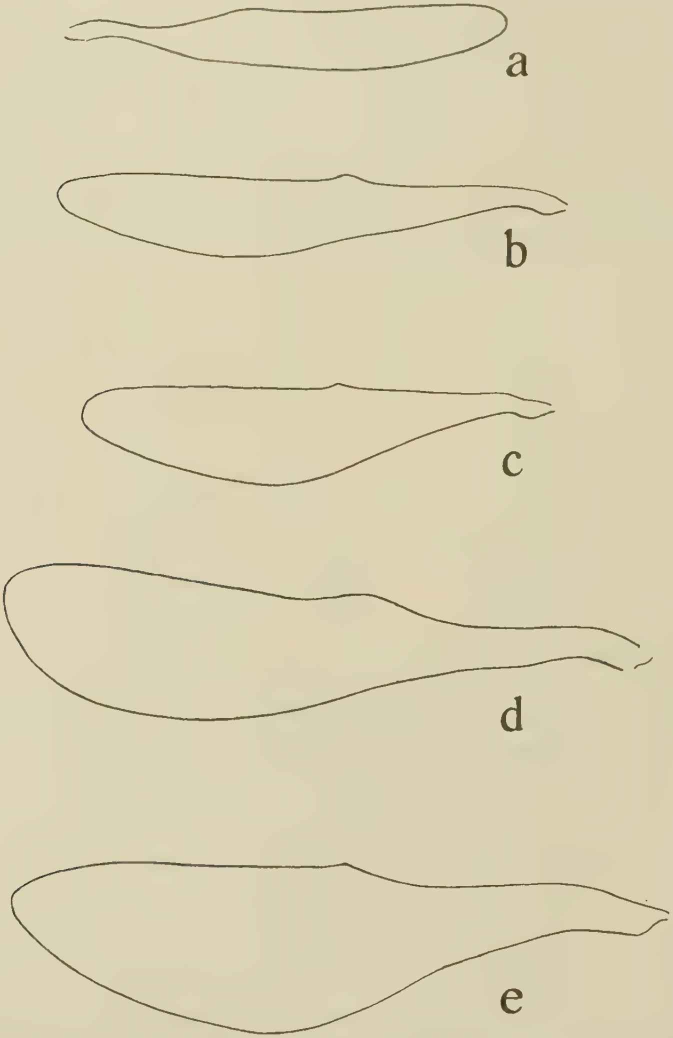


Fig. 10.—Hind-wing of female of a, *Telenomus nephele* sp. n.; b. *T. benefactor* Craw.; c, *T. atys* sp. n.; d, *T. pylades* sp. n.; e, *Microphanurus striaticeps* Dodd.

♂. Differs from the ♀ as follows :—

Antennae rather long, about two-thirds the length of the body, pale brownish-yellow in colour; funicle 1 and 2 twice as long as wide; 7 and 8 nearly $1\frac{1}{2}$ times as long as wide. Fore-wings distinctly brownish; the somewhat ill-defined postmarginalis is about 3 times as long as the stigmalis. Genitalia (fig. 8). Length : ♂♀, 1·1 mm. approx.

UGANDA : Kampala (*H. Hargreaves*) : series of 17 ♀♀, 15 ♂♂, bred 12.xii.1929 from eggs of *Harpacton tristis* St.

This species is by no means typical of the genus and is somewhat unnaturally placed therein. The following species has much in common with it, but in sculpture and pubescence approaches nearer to a typical *Telenomus.*

Telenomus pylades is largely characterised by the shape and sculpture of the head, which sculpture, it should be noted, differs from that of typical *Telenomus* only in degree, and by the pubescence of the mesonotum combined with the form of the abdomen.

(19) **Telenomus iphias** sp. n.

In general appearance much like *pylades*, with which it may be compared as follows :—

♀. Scape of the antennae and the legs sometimes darker. Funicle brownish-black. *Head* : frons in front of the ocelli and vertex between the ocelli, extremely finely granulate, but though the surface is dull as in *pylades*, the sculpture is indefinite. Temples hardly produced backwards, so that the posterior part of the vertex is merely evenly rounded; the surface here is very finely rugose, without the well-separated granulations characteristic of *pylades. Thorax* : mesonotum somewhat shining, with a very fine, indefinite sculpture and clothed with the short, brownish, adpressed hairs characteristic of *Telenomus.* Fore-wings distinctly brownish, over-reached a little by the acuminate apex of the abdomen; stigmalis sometimes very indistinct; postmarginalis better defined than the stigmalis and reaching nearly to the apex of the wing, its limits shown by the even row of short bristles which arise from it. *Abdomen* fully 2½ times as long as wide, similar to that of *pylades* but differing in having the apex much more sharply narrowed (fig. 9). Length : 1·2 mm. approx.

♂. Like the ♀ in sculpture. It differs from the ♂ of *pylades* also as follows :—

Antennae at first sight very like those of the ♀, being distinctly clavate after funicle 3; funicle 1 is very slightly longer than wide; 4–9 strongly transverse. Abdomen slightly longer and narrower than in *pylades.* Length : 1 mm. approx.

UGANDA : Kampala (*H. Hargreaves*) : series of 7 ♀♀, 3 ♂♂, bred from eggs of *Harpacton tristis* St.

It is interesting to note that this and the preceding species were bred together on the same day and from the same host. The two series had originally been mounted as one.

Telenomus pylades and *iphias* are closely and naturally related, although very distinct from each other. It becomes rather difficult to define this relationship, which is apparent enough when the two species are seen. Both have a similar elongate form, a head which is by no means strongly transverse, rather narrow fore-wings, hind-wings broadest beyond the middle, and a similar, subtly distinctive abdomen.

(20) *Telenomus gowdeyi* Crawford.

T. gowdeyi, 1911, *Proc. U.S. nat. Mus.*, **40** : 441 (♂♀).
Liophanurus gowdeyi, Kieffer 1926, *Das Tierreich*, **48** : 72.

The female of this species is remarkable on account of the much attenuated abdomen and the shape of the apical tergites. The male departs but little from the uniformity common to nearly all the males of *Telenomus.*

Crawford's description may be amplified as follows :—

♀. *Head* a little more than twice as wide as long, 9 : 4, seen along a line perpendicular to a line between the posterior ocelli. Frons almost everywhere entirely smooth and shining. Vertex somewhat sharply angled between the posterior ocelli; between the posterior ocelli it is finely and somewhat vaguely scaly-reticulate; this sculpture extends in front of the posterior ocelli where the surface contains some tiny punctures. *Thorax*: mesonotum with fine, indefinite sculpture; there is some indication of microscopic punctuation, but the punctures are extremely ill defined and the surface between them is scratched. Lateral, raised areas of the propodeum coarsely reticulate-rugose, especially towards the inner margin. Stigmalis of fore-wings long; postmarginalis well defined and nearly twice as long as the stigmalis. *Abdomen* between 4 and 6 times as long as wide, widest in its basal third and thence tapering to a point; tergite 2 with short striations at its base and with its entire apical margin conspicuously emarginate; tergites 3, 4 and 5, each with a short lateral incision (fig. 11). The length of the abdomen is variable and depends, further, upon whether the apical segments are retracted or not. Length: 1·2–1·7 mm.

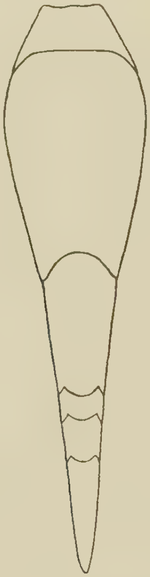


FIG. 11.—*Telenomus gowdeyi* Crawford, ♀; abdomen dorsal.

♂. Antennae: scape yellow; pedicel and funicle pale brownish-yellow. Lateral areas of the propodeum in large part, nearly smooth. Abdomen fully twice as long as wide, rather strongly narrowed basally; tergite 2 considerably longer than wide, its apical margin shallowly emarginate; following segments also emarginate at the apex but more feebly so than 2. Length: ·9 mm. approx.

UGANDA: Entebbe (*C. G. Gowdey*): several series bred from eggs of *Anaphe infracta* and *Anaphe* sp.

The shape of the abdomen in the ♂ is quite distinctive.

According to Kieffer's key to the TELENOMINAE given in *Das Tierreich*, **48**: 15, the two following species, for which a new genus has been erected, would be placed in *Microphanurus*, and this, on the strength of having a postmarginalis to the fore-wings (though not well defined), glabrous eyes, no clearly marked parapsidal furrows and striations at the base of the second tergite.

(I have yet to see a Telenomine which is entirely without any form of striation at the base of the second tergite, such as is supposedly the case in *Phanurus* and *Liophanurus*!) The general facies, that is, the markedly narrow form, shows them to have no natural affinity with *Microphanurus*; the unusual shape of the head, the small eyes and the two extra grooves on the frons are characters not found in this genus. The narrow, cylindrical thorax, again, is peculiar and distinctive. Aberrant though the genus undoubtedly is, I freely admit that I would have preferred to include it in *Telenomus* rather than propose a new name for it, but complete absence of hairs on the eyes would not admit this.

Nirupama gen. n.

The following description is generic only in so far as it covers the two species for which it has been drawn up.

Head a little flattened antero-posteriorly and prolonged between the vertex and the mouth. An extremely fine groove extends from the anterior ocellus to the weak keel between the antennal insertions. Another, still finer groove, extends from the mandibles to the eye, just in front of the lowest point of the latter; this is quite distinct from the sharply defined genal sulcus. Eyes bare, small, not, or hardly, longer than the cheeks. Antennae 11-segmented in the ♀, 12-segmented in the ♂. *Thorax* narrow, somewhat cylindrical. Fore-wings with the stigmalis markedly short. Legs short, stout, the femora markedly dilated. *Abdomen*: segment 1 not strongly transverse, about 1½ times as wide as long; 2 considerably longer than wide, its apical margin widely emarginate in the ♀, more or less straight in the ♂. The abdomen is sharply acuminate in the ♀ and in this sex shows 4 segments when these are in their normal position; in dried specimens the 4th tergite is frequently retracted completely beneath the 3rd. Tergite 3 in the ♂ unusually long, the following segments disproportionately short.

Genotype *N. morpheus* sp. n.

Nirupama morpheus sp. n.

♀. Colour black. Scape of the antennae in greater part light brownish with the base and apex paler; pedicel and first 5 segments of the funicle brownish-yellow; rest of the funicle darker. Legs brownish-yellow, the femora more infuscated than the other parts. Tergite 1 reddish-brown; rest of the abdomen more or less black. *Head* seen from above along a line perpendicular to a line between the posterior ocelli strongly emarginate behind. Vertex between the posterior ocelli sharply angled and falling away perpendicularly to the occipital margin; there is no differentiated ridge across the vertex. Head between the mouth and the posterior ocelli entirely smooth almost everywhere; only just in front of the posterior ocelli is there some vague scaly-reticulate sculpture. Along the inner eye-margin a row of small, ill-defined punctures is feebly indicated. Face behind the eyes scaly-reticulate, the meshes comparatively large. Frons between the antennal insertions and the lower inner margin of the eye somewhat bulging. Antennae: scape normal, not unusually widened towards the apex; funicle 4 a little nearer in size to 3 than to 5 so that the club is more or less 5-segmented (fig. 12). Clypeus appearing feebly emarginate at its apex; this is largely due to the chitin being reduced to a mere membrane here, the thick parts of the clypeus showing as a more or less semi-circular ring at the sides and base. *Thorax*: mesonotum in greater part virtually unsculptured; parapsidal furrows represented by a conspicuous but very uneven, depressed band of finely rugose or almost granulate sculpture; on the central part of the mesonotum, there is present, at the most, an extremely faint scaly-reticulate sculpture. The antero-lateral margin of the mesonotum is punctate and the postero-lateral margin shows a costate furrow, widest in the middle. Scutellum faintly scaly-reticulate. Postscutellum with only a very feebly roughened central swelling. Mesopleurae smooth except for a row of irregular pits along the diagonal depression and a short, more or less transverse punctate groove at right angles to this. *Abdomen* elongate, normally much attenuated towards the apex, fully 3 times as long as wide; tergite 1 about 1½ times as wide as long, its apical half somewhat swollen, especially medially; the basal striae do not extend over the swollen apical half; 3 distinctly longer than its basal width, more or less funnel-shaped and in dried specimens often completely concealing the apex of the abdomen. Length: 1·1 mm. approx.

♂. Differs from the ♀ as follows:—

Antennae: scape very slightly more widened apically. Scape, pedicle and first 3 or 4 segments of the funicle more or less yellow; rest of the funicle darker; funicle slightly thickened towards the apex; segments 5–9 slightly transverse; 3 produced beneath at the apex. *Abdomen* much less elongate. Tergite 1 not or hardly swollen on its apical half, the striae extending to nearly the apex of the segment; 2 fully 1½ times as long as wide; 3 unusually long and frequently concealing the remaining segments. Length: ·9 mm. approx.

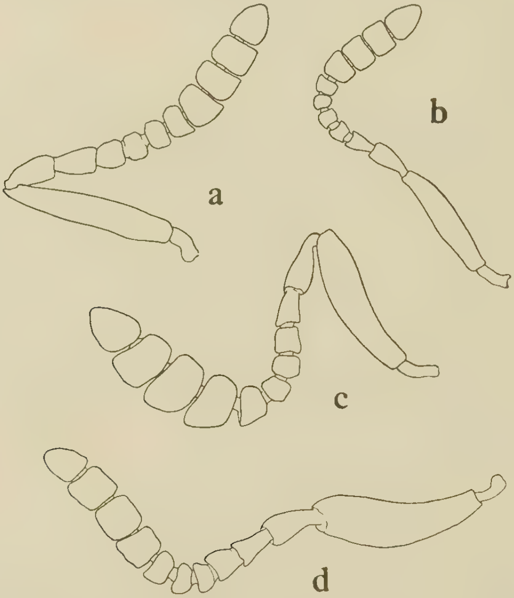


Fig. 12.—Female antenna of a, *Telenomus pylades* sp. n.; b, *Platytelenomus hylas* sp. n.; c, *Nirupama morpheus* sp. n.; d, *N. auge* sp. n.

Gold Coast: Afwerase (*W. H. Patterson*): series of 15 ♀♀, 4 ♂♂, bred 31.i.1922 from eggs of an hemipteron.

Nirupama auge sp. n.

This species was bred with *morpheus*. It is somewhat remarkable that this should be so, since both species clearly belong to the same genus and that, an aberrant one. At first, having examined only the females, I suspected that a species was present in which the female sex was strongly dimorphic.

A study of the males, however, revealed also two forms each of which could be correlated naturally with the two groups of females.

N. auge sp. n. differs from *morpheus* only in a few details, but these are determinative enough to exclude all possibility of confusion between the two species.

Head longer, seen from above, not so hollowed out behind; seen from in front, more prolonged than in *morpheus*, its length (to apex of mandibles) to its width across the eyes in the ratio of 21 : 16 (fig. 13). Antennae: scape markedly wider, flattened and somewhat hollowed out along its entire outer side to accommodate the funicle when this is folded back on to it; funicle a little shorter, all the segments a little less elongate (fig. 12). *Thorax*: mesonotum without the depressed bands of finely rugose sculpture; at the most there is a little, very faint, scaly-reticulate sculpture and then the surface is by no means depressed; the mesonotum is hence more or less smooth, shining and glabrous all over; its antero-lateral margins are less clearly punctate and its postero-lateral margins show a much less distinctly costate furrow. Postscutellum entirely smooth medially. Legs with the femora slightly more dilated. *Abdomen* slightly less elongate (fig. 13); tergite 1 not so much paler than the rest of the abdomen as in *morpheus*. Length: ·9 mm. approx.

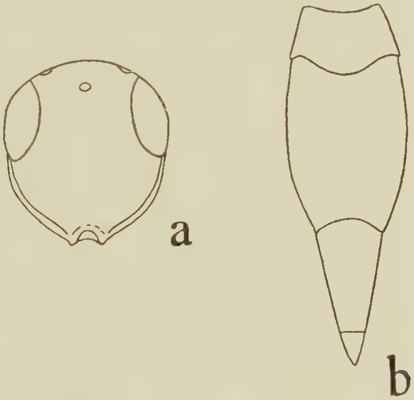


FIG. 13.—*Nirupama auge* sp. n., ♀; a, head from in front; b, abdomen dorsal.

GOLD COAST: Afwerase (*W. H. Patterson*): series of 15 ♀♀, 7 ♂♂, bred 31.i.1922 from eggs of an hemipteron.

The most readily appreciated character for separating these two species is the shape of the scape.

Microphanurus Kieffer.

In *Microphanurus* it is important to determine whether a species has a completely margined vertex (not to be confused with the occipital margin) and whether the frons is swollen between the antennal insertions and the lower, inner margin of the eye. Both these characters are easy to appreciate in the common *M. seychellensis* Kieff. (= *truncativentris* Dodd). The sculpture of the mesonotum, also, is a useful guide to the identification of the species. The degree of striation on the second tergite is unreliable as a specific character and, at best, is only of secondary importance. The shape of the abdomen is reliable for determination only within fairly broad limits. Unlike those genera of the related subfamily SCELIONINAE, with which I am acquainted, and in which the apical segments of the abdomen—with the exception sometimes of the last—are fused together, the corresponding segments in the TELENOMINAE are retractile and in death tend to be more or less telescoped one within the other.

Key to the Species (♀♀).*

1. Segments 3 and 4 of the funicle unusually strongly transverse, saucer-shaped, much wider than their greatest length; 2, 3 and 4 together about as long as, or even shorter than, 5. (Sp. with the mesonotum and the scutellum strongly and evenly reticulate-rugose) . *mopsus* sp. n.
   Segments 3 and 4 of the funicle not unusually strongly transverse; 2, 3 and 4 together considerably or much longer than 5 . . . . 2.
2. The carina bordering the hind margin of the eye is extended across the vertex just behind the posterior ocelli so that the vertex is divided by a sharp, smooth and more or less raised ridge into an anterior and a posterior part; the sculpture of the posterior (declivous) part is markedly different from that of the anterior part, being more or less smooth and polished. (All species have the face between the antennal insertions and the lower, inner margin of the eye conspicuously bulging when the head is seen from above) . . . . 3.
   This carina does not extend across the vertex or, if it appears to, it is ill defined and is neither smooth nor more or less raised . . . . 5.
3. Mesonotum without a trace of parapsidal furrows. (Sp. with the sculpture of the mesonotum often consisting largely of minute separated, raised points, the surface between the points somewhat smooth and shining; segment 4 of the funicle as long as wide and not fitting closely on to 5; tergite 2 considerably longer than wide, its striae extending hardly beyond the basal third) . . . . *seychellensis* Kieffer.
   Mesonotum posteriorly with short, sharply defined parapsidal furrows . 4.
4. Mesonotum extremely finely and closely scaly-reticulate, so that it appears finely rugose or granulated; genal sulcus crack-like . . *maro* sp. n.
   Mesonotum finely but very irregularly longitudinally striated on its posterior half or third; on its anterior part, the rugulosities consist of minute ripples or raised points; genal sulcus wide and gaping. (Sp. with 5 or 6 black club segments) . . . . *menecles* sp. n.
5. Face distinctly bulging between the antennal insertions and the lower, inner margin of the eye (sp. with short parapsidal furrows present posteriorly; the funicle entirely black or brownish-black; distinct, though not sharply defined punctures among the scaly-reticulate sculpture of the frons; mesonotum sometimes with distinct, *raised* wrinkles or reticulations) . . . . *enceladus*, sp. n.
   Face without these bulges. (Spp. without a trace of parapsidal furrows posteriorly) . . . . 6.
6. Eyes clothed with excessively short hairs. (Sp. with the entire frons very closely scaly-reticulate, almost finely rugose; mesonotum on its anterior half, delicately and vaguely reticulated) . . *Telenomus atys* sp. n.
   Eyes bare . . . . 7.
7. Mesonotum very characteristically sculptured, being very evenly and closely reticulated. (Sp. having cheeks with some 6 clearly defined sharp ridges which converge on the mouth; stigmalis unusually short for the genus; tergite 2 virtually striated all over, the surface between the close, somewhat wrinkled ridges being transversely sculptured) . . . . *striaticeps* Dodd.
   Mesonotum with more typical sculpture, that is, either finely or strongly rugose or with a tendency to reticulate-rugose . . . . 8.

---

* For ♂♂ start at couplet 2.

8. Mesonotum finely rugose, the sculpture consisting largely of minute raised points but posteriorly showing longitudinal rugosities. (Sp. with the radicle of the antennae more or less black) . . . *basalis* Wollaston.
   Mesonotum coarsely rugose . . . . 9.
9. Radicle of the antennae fully or hardly less than one-third the length of the scape and black. (Sp. with the genal sulcus wide and gaping) *aloysii-sabaudiae* Fouts.
   Radicle much less than one-third the length of the scape . . . . . 10.
10. Genal sulcus wide and gaping, margined in front by a distinct ridge which runs parallel to it from base of clypeus to lowest point of the eye; radicle of the antennae blackish . . . . *orontes* sp. n.
   Genal sulcus narrow, crack-like, not margined in front by such a ridge; radicle yellow . . . . *danaus* sp. n.

Microphanurus mopsus sp. n.

♀. Colour: first 6 segments of antennae and legs except the coxae, bright reddish-yellow. *Head* more than twice as wide as its greatest length, about 17 : 7. Frons with a large, shallow depression which is more or less distinctly traversed, at least above, by fine wavy lines; above, the lines tend to be closer and slightly more raised, so that the frons here has an indication of a feeble margin; frons otherwise (except towards the mouth) and the vertex in neighbourhood of the ocelli, very closely scaly-reticulate, with scattered ill-defined punctures; sometimes the surface here tends to be faintly roughened or granulated, in which case the punctures are still more ill defined. The margin bordering the eyes behind, is continued as a fairly sharply defined, raised ridge across the vertex, immediately behind the posterior ocelli. When the head is seen from above, the frons between the antennal insertions and the lower, inner margin of the eye, distinctly bulges but not so conspicuously asi n the two following species. *Antennae* very distinctive; radicle very short; first 4 segments of the funicle together about half the length of the rest together; 3 and 4 unusually strongly transverse and short; 2, 3 and 4 much compressed together, shorter than, or as long as, greatest length of 5; 5–9 gradually and conspicuously (especially after 6) decreasing in width towards 9; 9 very narrow, its greatest width only about half that of 6 (fig. 14). *Thorax* dull, somewhat densely clothed with pale adpressed hairs, with a fairly strong, raised, almost reticulate sculpture, that is, the sculpture consists of raised points anteriorly which posteriorly develop into ridges and irregular rugosities. Scutellum slightly more coarsely sculptured than the mesonotum. Postscutellum with a medial swelling which is irregularly longitudinally ridged. Wings yellowish, the venation pale; stigmalis long. *Abdomen* considerably longer than wide when the apical segments are not retracted; segment 2 very slightly transverse, strongly and evenly striated almost all over; segments 3–6 finely punctate, *when not retracted* together nearly as long as 2. Length: 1·9–2·4 mm.

Cape Province: Port St. John, June–July, 3 ♀♀. Abyssinia: Mt. Zuquala, Oct., 1 ♀ (*H. Scott*).

This species is chiefly characterised, in the female sex at all events, by the form of the antennae, by having the scutellum as strongly sculptured as the mesonotum and by the strong striations of the second tergite.

Microphanurus seychellensis Kieffer.

Telenomus seychellensis Kieff. 1910, *Bull. Soc. ent. Fr.*, **1910** : 294, ♂♀.
= *Telenomus truncativentris* Dodd. 1919, *Trans. ent. Soc. Lond.*, **1919** : 353.

The types of both Kieffer's and Dodd's species are in the British Museum, but the species could only doubtfully be recognised from the descriptions given by these writers. It may further be described as follows :—

Head: frons conspicuously bulging between the antennal insertions and the lower, inner, margin of the eye; at least between the antennal insertions and the anterior ocellus, it is entirely smooth and shining; elsewhere it is delicately scaly-reticulate and usually without punctures among this sculpture. On each side of the anterior ocellus and very close to it, there is nearly always a short, longitudinal row, each of about 6 small clearly defined punctures—sometimes the 2 rows unite behind the anterior ocellus. The margin bordering the eyes behind is continued as a sharply defined ridge right across the vertex. Antennae: funicle hairy, somewhat slender, the segments rather loosely articulated; funicle 1 fully twice as long as wide; 2 considerably longer than wide; 4 more or less square in outline; the club is feebly 5-segmented. *Thorax*: mesonotum with its sculpture consisting nearly everywhere of minute raised granulations; posteriorly there is rarely an indication of fine longitudinal wrinkles. The sculpture is much more characteristic of *Telenomus* than of *Microphanurus*. Scutellum almost smooth and shining with long brownish hairs which are longer than those of the mesonotum and all of which tend to converge slightly. *Abdomen*: when the segments are not retracted, it is nearly twice as long as wide, about 7 : 4; tergite 2 very distinctly longer than wide, its striae not extending to the middle of the segment, and approaching the middle only medially. The truncate apex of abdomen mentioned by Dodd is of course the result of retraction of segments and has no specific value.

ABYSSINIA: Mt. Zuquala, *ca.* 9000 ft. (*H. Scott*), 1 ♀. SEYCHELLES, Type series of *seychellensis* Kieff. BRIT. E. AFRICA: Nairobi, Type series of *truncativentris* Dodd, bred from eggs of *Antestia variegata*. TANGANYIKA TERR.: Moshi (*A. H. Ritchie*): series bred from eggs of *Antestia lineaticollis*. UGANDA: Toro (*G. R. L. Hancock*): series from eggs of *Antestia lineaticollis*; Kampala (*H. Hargreaves*): series from eggs of *Agonoscelis versicolor*. CAPE PROVINCE: Mossel Bay and Port St. John: numerous examples from both localities.

The species is characterised by the frontal bulges, punctures on each side of the anterior ocellus and by the completely margined vertex.

Microphanurus menecles sp. n.

♀. Colour: first 6 segments of the antennae including the radicle, and the legs, brightly yellowish. *Head* viewed from above, along a line perpendicular to the margin behind the posterior ocelli, more than twice as wide as its greatest length, about 12 : 5. Frons between the antennal insertions and the lower, inner, margin of the eye conspicuously bulging; frons, except above the antennal insertions where the surface is delicately transversely striated, everywhere clearly scaly-reticulate, with scattered, ill-defined punctures, which tend to be closest together toward the eye-margin. The margin bordering the eyes behind is continued as a very sharply defined ridge right across the vertex immediately behind the posterior ocelli. Antennae: radicle very short; funicle 1 more than twice, sometimes nearly 3 times, as long as wide; 3 bead-like; 3 and 4 together longer than 5; 4 fits rather more closely on 5 than 3 on 4 so that the club is feebly 6-segmented; this last is somewhat slender and is slightly narrowed towards the apex. The genal sulcus, especially when seen from in front, is wide and gaping. *Thorax*: the sculpture of the posterior half of the mesonotum consists largely of very irregular, fine, raised wrinkles; anteriorly these wrinkles break up into tiny raised points and irregular rugosities; the surface everywhere between the raised sculpture is often very shining. Parapsidal furrows nearly as long as the scutellum, deep and well defined. Scutellum less strongly sculptured than the mesonotum, usually with at least some raised lines, but sometimes with only a feeble scaly-reticulate sculpture. Postscutellum with a feeble medial swelling which is longitudinally ridged, often very irregularly. Wings as in *mopsus* sp. n. *Abdomen* but little longer than wide even when the segments are not retracted; segment 2 very delicately striated, the striae extending to within a quarter of the apex of the segment. Length: 1·2–2·2 mm.

♂. Antennae yellow, slightly infuscated towards the apex, somewhat slender; segments 5–9 of the funicle fully as long as wide. *Abdomen* less wide than in the female, its apex more rounded when the segments are not retracted. Length: 1·3 mm.

CAPE PROVINCE: Mossel Bay, Nov.–Jan., 9 ♀♀, 2 ♂♂; Ceres, March, 1 ♀. NATAL: Kloof, Aug.–Sept., 2 ♀♀. E. CAPE PROVINCE: Katberg, 4000 ft., March, 1 ♀.

Microphanurus maro sp. n.

This species is clearly very closely related to *menecles* sp. n. and differs from it as follows:—

♀. Colour: funicle almost entirely black; only the base of segment 1 tends to be pale; the pedicel, though generally yellowish like the scape, is sometimes darkened above. *Head*: frons sometimes less punctured than in *menecles*. *Thorax*: mesonotum on its posterior half or two-thirds, without longitudinal rugosities, the surface being very finely scaly-reticulate, sometimes very finely rugose; anteriorly the surface tends to show the normal raised points, but they are very feeble. Scutellum often nearly smooth, apparently never with raised lines or rugosities. *Abdomen*: striations of tergite 2 sometimes strong and distinct to a little beyond the middle, sometimes so feeble as to leave the segment almost smooth.

♂. Funicle usually entirely blackish but sometimes uniformly brownish. Otherwise like the ♀.

CAPE PROVINCE: Mossel Bay, Oct.–Feb., 27 ♀♀, 2 ♂♂; May–Aug., 5 ♀♀, 10 ♂♂; Ceres, Feb.–April, 9 ♀♀; Somerset East, Oct.–Dec., 5 ♀♀; Nov., 2 ♀♀. NATAL: Sarnia, April, 1 ♀.

This insect is readily distinguished from *Microphanurus menecles* by the sculpture of the mesonotum and of the scutellum.

Microphanurus enceladus sp. n.

Species very closely related to *maro* sp. n., and perhaps only a variety of it. It differs from that insect as follows:—

Head: frons a little less bulging between the antennal insertions and the lower margin of the eye, its sculpture closer, less delicate, and generally, much more thickly punctured, though, as in *maro*, the punctures are ill defined. The sharp margin behind the eyes fades out just behind the posterior ocelli, so that the anterior part of the vertex is separated from the posterior (declivous) part only by a very sharp angle. *Thorax*: mesonotum in 3 specimens with a very fine but clearly raised sculpture, approaching that seen in *menecles*, but very much finer. In one specimen (Somerset East), the sculpture is similar to that of *maro*, but, in addition, there is in this specimen, a clearly defined central carina and the surface between this carina and the short parapsidal furrows tends to be almost smooth. Scutellum in the Somerset East specimen perfectly smooth and shining, but in the others with the fine sculpture characteristic of *maro*.

CAPE PROVINCE: Somerset East, Sept., 1 ♀, Type; Port St. John, Aug.–Sept., 2 ♀♀; George, June, 1 ♀.

The sharp margin of the vertex is so constant throughout the long series of *maro*, that its absence along the distance between the posterior ocelli in the above 4 individuals would seem to justify at least a provisional separation. The type female from Somerset East might further have suggested another species on account of the sculptural variations mentioned above, but until more material is to hand, and the limits of specific variation can be more properly estimated in so difficult a genus as *Microphanurus*, it is perhaps wiser to avoid still further division.

Microphanurus striaticeps Dodd.

Telenomus striaticeps Dodd, 1919, *Trans. ent. Soc. Lond.*, **1919** : 355.

Dodd's description may be further amplified as follows :—

♂♀. *Head* : face without frontal bulges. Frons between the antennal insertions and the eyes with sharply defined even ridges which converge on the mouth. Frons in front of the ocelli with coarse longitudinal rugosities; above the antennal insertions there are well-marked transverse ridges which merge into the longitudinal rugosities towards the eye-margin; between all these rugosities the surface is entirely smooth and shining. Vertex between the ocelli dull, with a close, even, reticulate sculpture similar to that of the mesonotum. There is no trace of a sharp ridge across the vertex and the vertex itself is by no means sharply angulate. Genal sulcus marked by a fine sharp ridge. *Thorax* : mesonotum and scutellum dull, very characteristically sculptured, everywhere very closely and evenly reticulated or thimble-punctured. Fore-wings whitish, the stigmalis shorter than in any other African *Microphanurus*. Hind-wing (fig. 10). *Abdomen* : tergite 2 quadrate, longitudinally striated or wrinkled all over, the surface transversely sculptured between the raised rugosities. The sculpture of this tergite is very characteristic and quite unlike that of any other African *Microphanurus*.

NYASALAND : Mt. Mlanje, Type series bred from eggs of a Pentatomid.

BRIT. SUDAN : Wad Medani (*H. B. Johnston*) : series from eggs of *Acanthomia brevirostris* on *Cajanus indicus*. S. NIGERIA : Ibadan, series from unknown eggs. CAPE PROVINCE : Worcester, March, 2 ♂♂.

On account of the sculpture of the head, thorax and abdomen, this is perhaps the most distinct species of *Microphanurus* dealt with in this paper. The short stigmalis of the fore-wing is also very characteristic.

Microphanurus basalis Wollaston.

Telenomus basalis Woll. 1858, *Ann. Mag. nat. Hist.*, (3) **1** : 25, ♂♀.
= *Telenomus maderensis* Woll. 1858, *Ann. Mag. nat. Hist.*, (3) **1** : 25, ♀.
= *Telenomus megacephalus* Ashm. 1894, *J. linn. Soc. Lond.*, **25** : 212, ♀.
Microphanurus megacephalus Kieff. 1926, *Das Tierreich*, **48** : 76.
= *Telenomus piceipes* Dodd, 1919, *Trans. ent. Soc. Lond.*, **1919** : 354, ♂♀.

The above synonymy has been established by examination of the types, except in the case of *megacephalus* Ashm., where specimens determined by Mr. A. B. Gahan of the U.S. Bureau of Entomology have been regarded as representative of Ashmead's species.

This species is a parasite of the eggs of the hemipteron *Nezara viridula* and has been bred in Africa and U.S.A.

Wollaston's descriptions are worthless and neither Ashmead nor Dodd has, in my opinion, succeeded in describing the species adequately. The following notes will, it is hoped, fix its position at least among its African relatives.

♀. Colour : radicle of the scape more or less black; scape yellow; first 4 segments of the funicle brownish. *Head* more or less dull; seen from above, along a line perpendicular to a line between the posterior ocelli, nearly two and a half times as wide as its greatest length, about 12 : 5. Frons without a depression above the antennal insertions and without bulges between the antennal insertions and the eyes. Frons between the antennal insertion and the eye very closely scaly-reticulated, almost finely rugose. Above the antennae, the surface is very delicately transversely striated or wrinkled, although the strength of these striations is variable. Frons in front of the ocelli and usually along the inner eye-margin very closely scaly-reticulated, almost finely rugose; sometimes the striations above the antennae reach the eye-margin. There is no trace of a fine, sharp ridge across the vertex. Antennae: radicle longer in proportion to the length of the scape than in the other African species, except *aloysii-sabaudiae* Fouts; funicular segments closely articulated and in this respect, unlike *seychellensis* Kieff. (fig. 14). Genal sulcus narrow and crack-like. *Thorax*: mesonotum sculptured much as in *seychellensis*, but the sculpture is stronger and on the posterior half more or less, the raised points tend to form themselves into very distinct longitudinal wrinkles, so that longitudinal rugosities are, as a general rule, a marked feature of the mesonotal sculpture. There is no trace of parapsidal furrows. Scutellum irregularly covered with raised points. *Abdomen* a little

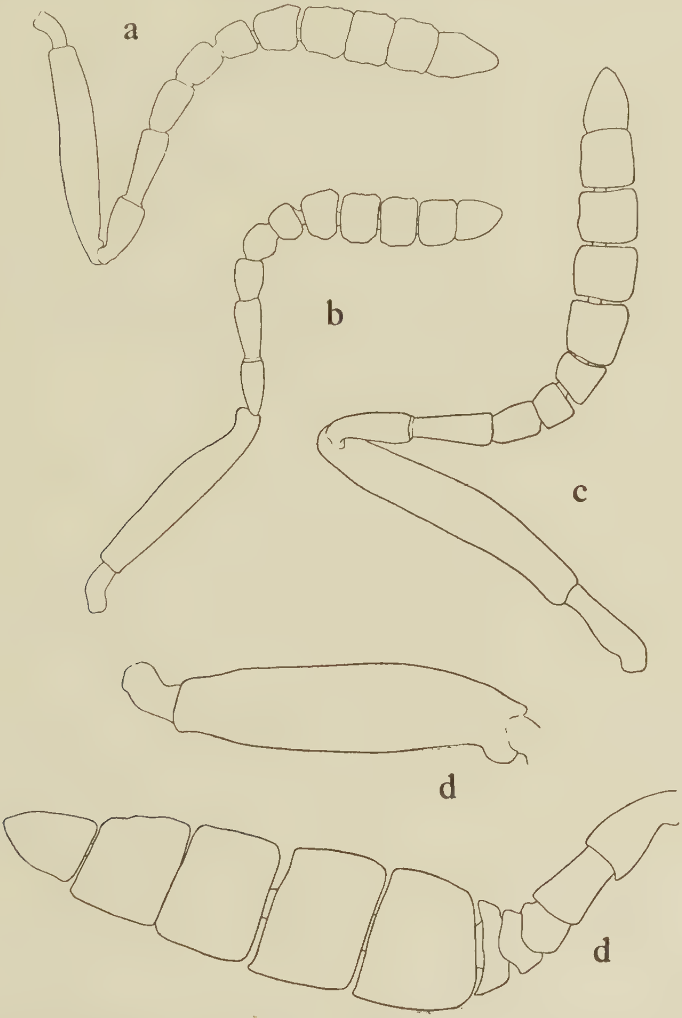


FIG. 14.—Female antenna of a, *Telenomus pyramus* sp. n.; b, *Microphanurus basalis* Wollaston; c, *M. aloysii-sabaudiae* Fouts; d, *M. mopsus* sp. n.

longer than wide when the segments are not retracted, about 11 : 8; tergite 2 distinctly transverse, its striae sometimes very feeble, sometimes strong and usually extending a little beyond the middle of the segment.

♂. Scape, pedicel and first 5 segments of the funicle more or less yellow or all the funicular segments blackish as in the type series of *piceipes* Dodd; funicle 2 nearly twice as long as wide; 4 considerably longer than wide.

Distribution: U.S.A.; WEST INDIES (Type of *megacephalus* Ashm.); MADEIRA (Types of *basalis* and *maderensis* Woll.); BRIT. E. AFRICA: Songhor, Type series of *piceipes* Dodd, bred from undetermined eggs on coffee; EGYPT (*H. Priesner*), bred frequently from the eggs of *Nezara viridula*; SUDAN: Wad Medani (*W. P. L. Cameron*): 1 ♀ from eggs of *Agonoscelis versicolor*; TRANSVAAL: Barberton (*G. C. Ullyett*): series from eggs of *N. viridula* on cotton; CAPE PROVINCE: Ceres, 2 ♀♀, 1 ♂; Mossel Bay, 1 ♀; Somerset East, 1 ♀.

Microphanurus basalis Woll., is at once separated from *M. seychellensis* Kieff., by its unmargined vertex and transverse 2nd tergite. Its nearest ally appears to be *M. aloysii-sabaudiae* Fouts, from which species it is most readily separated by having the sculpture of the mesonotum finer and with longitudinal rugosities much more in evidence on this sclerite.

Microphanurus aloysii-sabaudiae Fouts.

1930, *Boll. Soc. ent. Ital.* **62** : 118.

This species is closely related to *maro* and *menecles* spp. n., but agrees in sculpture more with *menecles*. It may be compared with this species as follows :—

♀. Colour: radicle of the scape black. *Head*: frons not at all bulging between the antennal insertions and the lower, inner margin of the eye; the head, in consequence, appears more transverse; frons between the antennal insertions and the eyes quite strongly rugose; above the antennal insertions it is strongly, irregularly ridged and these ridges tend to meet the middle of the eye-margin; frons near the ocelli, and the vertex between the ocelli, so closely scaly-reticulate as to appear almost finely rugose or granulate. Carina bordering the hind margin of the eye not continued as a sharp ridge across the vertex, although the anterior part of the vertex forms with the posterior (declivous) part an acute angle. Antennae: radicle slender, its curvature much before the middle, fully two-thirds the length of the scape (fig. 14); in ♂ cotypes, the radicle is somewhat thicker. *Thorax*: mesonotum strongly and fairly evenly reticulate-rugose; posteriorly, the rugosities show a tendency to become longitudinal only on the posterior quarter, but in a doubtful ♀ from Katberg, there is longitudinal sculpture extending to as far as the middle of the mesonotum.

ITALIAN SOMALILAND (*Duca Abruzzi*), Type series bred from eggs of *Nezara viridula* and *Nezara pallidoconspersa*. UGANDA: Kampala (*H. Hargreaves*): series of 8 ♀♀ and 2 ♂♂, from eggs of Hemiptera on *Crotolaria* sp. CAPE PROVINCE: Port St. John, June–July, 2 ♀♀. E. CAPE PROVINCE: Katberg, 4000 ft., Jan., 1 ♀.

This species is distinct on account of the long black radicle of the scape, the absence of frontal bulges and the coarse sculpture of the mesonotum.

Microphanurus orontes sp. n.

♀. Species differing from *aloysii-sabaudiae* Fouts, only in having the radicle of the scape very short, much less than one-third the length of the scape, curved more or less in the middle.

Cape Province: Port St. John, April, 1 ♀; July, 1 ♀.

This species is remarkably like *aloysii-sabaudiae*, but the difference in the shape and length of the radicle is too obvious a feature to be disregarded.

Microphanurus danaus sp. n.

This is another species closely related to *aloysii-sabaudiae* but very clearly distinct from it.

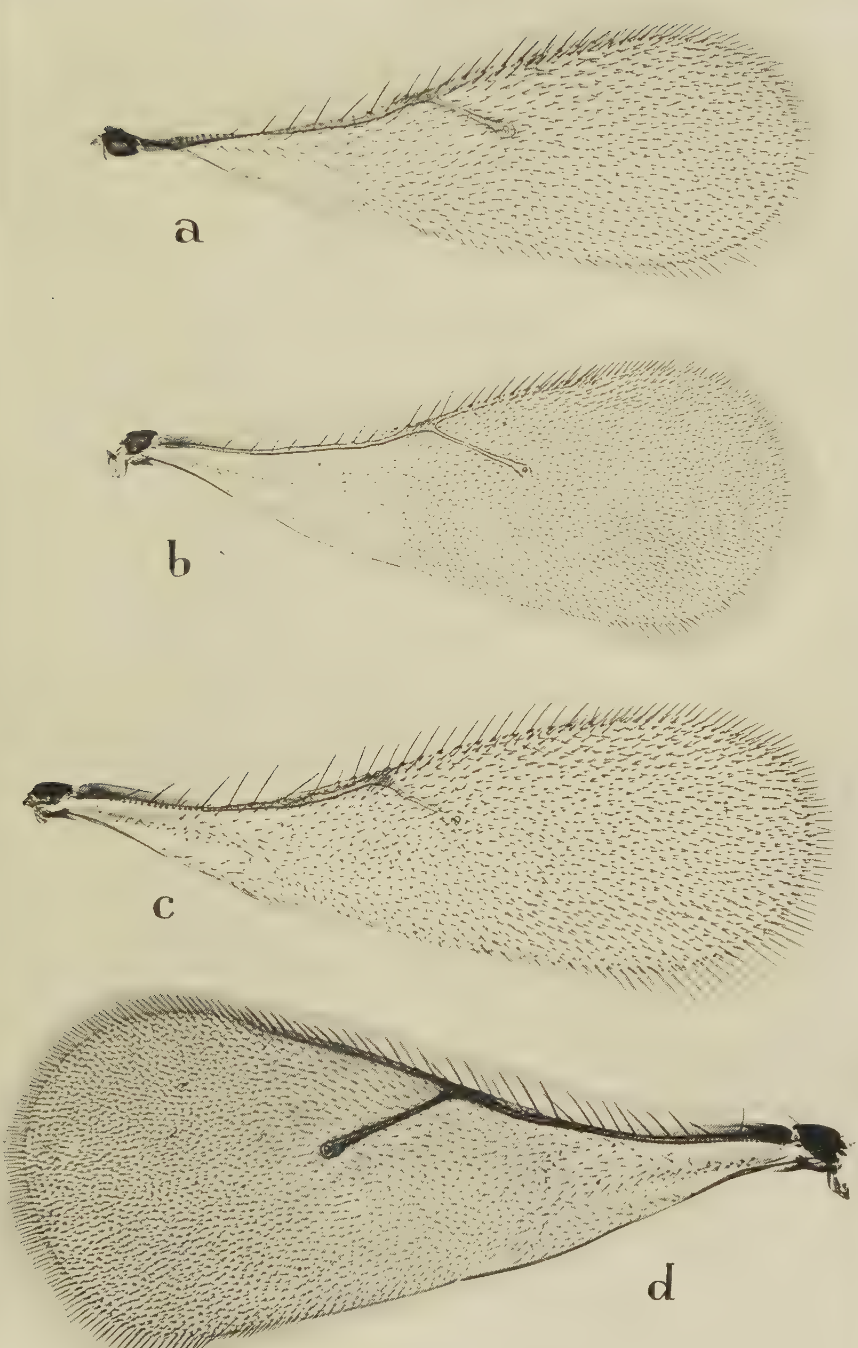
♀. Colour: legs dirty yellow. Radicle and scape of the antennae of the same colour as the legs, but the scape is infuscated on the apical quarter above; pedicel and first 4 segments of the funicle brownish. *Head* strongly transverse, seen from above, along a line perpendicular to a line between the posterior ocelli, nearly 3 times as wide as its shortest length. There is no trace of a bulge between the antennal insertions and the eyes. Frons duller and more characteristically sculptured than in *aloysii-sabaudiae* though the type of head sculpture is similar in the two species; between the antennal insertions and the lower margin of the eye, the surface is almost finely granulate; in the middle of the face against the eye-margin, this sculpture merges into tiny raised wrinkles or irregular rugosities which in their turn merge into the strong, fairly regular ridges above the antennal insertions; frons towards the ocelli appearing dull and much more closely sculptured, the sculpture fine, raised, and consisting of feeble ridges and wrinkles. In the other allied species, the sculpture here tends to be predominately scaly-reticulate. Margin bordering the eyes behind not extended as a sharp ridge across the vertex although there is a very acute angle between the anterior part of the vertex and its posterior (declivous) part. Eyes rather large. Antennae: radicle many times shorter than the scape; the latter longer than in *aloysii-sabaudiae*; club considerably more thickened in the middle than in *aloysii-sabaudiae*. Genal sulcus narrow and crack-like. *Thorax* strongly and unusually evenly convex. Mesonotum strongly, closely and very evenly reticulate-rugose, the sculpture less coarse and much closer than in *aloysii-sabaudiae*. Scutellum sculptured like the mesonotum. *Abdomen*: tergite 2 strongly transverse, feebly striated over its basal half. Length: 1 mm. approx.

Cape Province: Port St. John, Aug., 2 ♀♀.

This species has a very distinctive facies, probably due to its strongly convex thorax with the even sculpture of this. It has much in common with *aloysii-sabaudiae* from which it can be separated satisfactorily only by the shorter radicle and a different degree of sculpturation.

Explanation of Plate V.

Fore-wing of a, *Telenomus brimo* sp. n.; b, *T. cybele* sp. n.; c, *T. thestor* sp. n.; d, *T. numitor* sp. n.



Forewings of *Telenomus* spp.

A CONTRIBUTION TO THE CLASSIFICATION OF THE COLEOPTEROUS FAMILY LUCANIDAE

By Gilbert J. Arrow.

(*British Museum* (*Nat. Hist.*).)

[Read 6th March, 1935.]

With Plate VI and Five Text-figures.

A brief systematic study of the Stag-beetles (Lucanidae) has had the result of presenting very urgently to my mind two questions of wide application :—

1. Can genera be conveniently founded upon characters confined to one sex ?
2. Have subgeneric names any practical value ?

Both these questions I have been impelled to answer in the negative, although in the first case exception may no doubt be made where one sex is actually degenerate, that is, has lost important organs, or where, as in Mammalia, the two sexes can always be found together.

These questions are of vital importance to the classification of the Lucanidae, which are constantly taken singly; in which the two sexes often differ to a degree hardly equalled in any other group where there is no degeneration; and in which the individuals of one sex (male) of a species are subject to a greater range of variation than in any other group known to me.

The classification of this family has not been substantially improved since volume 3 of Lacordaire's *Genera des Coléoptères* appeared in 1856. In 1845 appeared a tabular conspectus, apparently the work of Westwood although printed anonymously. In this most of the known species were referred to the genus *Lucanus*, but a number of divisions based in the main upon features confined to the male sex, were named and called subgenera, sexual characters being evidently regarded by the author as insufficient for establishing genera. Lacordaire omitted most of these names as without value, mentioning as sections either of *Lucanus* or *Dorcus* only the best marked of them. Several of these have good distinctive characters in both sexes and have quite reasonably been since regarded as genera, but practically all later authors have treated as generic nearly all the subgeneric names introduced by Westwood, adding many more also based upon features of the male alone.

It is unnecessary to emphasise the extreme inconvenience of a system of classification in which the distinctive features of the genera cannot be found in one sex nor in all individuals of the other. When, as frequently happens, a new name is given to a species of which no male, or at least no very well-developed male, is known, a genus is chosen at random. Many examples of this can be found. On a recent visit to the British Museum M. René Oberthür recognised the type (a unique female) of *Dorcus rudis* Westw., as identical with that of *Prosopocoelus sulcatipennis* Houlb., in his own collection. It is still impossible to say to which of the numerous genera at present recognised, and referable according to Van Roon to different subfamilies, the species belongs although it has been known for seventy years and is represented in various collections.

Again, the name *Hemisodorcus dvalin* has been bestowed by Kriesche upon a female form taken by Roepstorff in the Andaman Islands. It is evident from the description that this is *Prosopocoelus wimberleyi* Parry, of which a good series representing both sexes, collected by Roepstorff, is in the British Museum. The female differs from that of *P. biplagiatus*, with which Kriesche has compared it, especially by its pointed prosternum and curved front tibiae. The two genera *Hemisodorcus* and *Prosopocoelus* belong, according to the catalogue, to different subfamilies.

Another specimen in M. Oberthür's collection is the type of *Pseudolucanus mniszechi* Planet, but a careful examination of this has shown it to be a very small female of the well-known *Lucanus westermanni* Hope. The small size of the specimen no doubt led to its association with those small species to which the name *Pseudolucanus* has been given, but size alone is an obviously inadequate ground for a generic separation. The male head and mandibles in these small-sized species, although very unlike those of highly developed examples of large species, show no such disparity when compared with lowly developed examples; but, putting aside these excessively inconstant sexual features, the undivided genus *Lucanus* is found to form a natural unit, both sexes of which are immediately recognisable. The lowest stage of development in the genus appears to be represented by *Lucanus gracilis* Albers. The type of this, supposed to be a female, I have found to be really a male with the mandibles very little differentiated from those of the female. Whether larger males show any considerable development of the mandibles is unknown. Experience shows that the smallest males of any strongly dimorphic species have the head and mandibles reduced to a condition in which they bear little or no resemblance to those of fully developed specimens. This tendency to severe reduction is characteristic of secondary sexual features and obviously renders them unsuitable for generic use.

As to the use of subgeneric names, it seems inevitably to happen that names introduced as subgeneric, for the reason that the designated groups are not sufficiently well defined to form genera, are soon after treated as generic names and when their shortcomings in this character are discovered other names are invented for those species which cannot be fitted into them, instead of the mistake being recognised. The same species is quoted under two generic names and confusion invariably results. Subgeneric names appear to me to have no advantage which outweighs this serious defect. Subdivisions of genera are of course necessary, but names for them are not. They can be very conveniently designated by the name of a typical species. The introduction of unnecessary names, instead of facilitating classification, is a serious hindrance to it. Various groups of insects which, like the LUCANIDAE, have attracted a special amount of attention from systematists have arrived at a state approaching chaos in nomenclature from this cause.

In his "Notes on the Lucanidae contained in the British Museum and the Oxford University Collection," published in *Trans. ent. Soc. Lond.*, **1913**, Boileau passed unnoticed certain important type-specimens in the former collection, to which it seems desirable to call attention. In particular he was unaware of those of Fabricius contained in the Banks collection, which is not incorporated with the general collection, and those of Hope, from the Hardwicke collection, described in Gray's *Zoological Miscellany*, 1831, although he mentioned one of the latter, *Lucanus villosus* Hope, actually the unique type, as possibly the type of its species. This, together with the other very numerous species of Coleoptera described as in General Hardwicke's collection, was received by the British Museum in 1835 as part of the important Hardwicke Bequest. Hope retained for his own collection, now at Oxford, a set of such of the species as were in duplicate, but the complete series of types is to be found in the National Collection.

The types of LUCANIDAE in the Banks collection are the following :—

Odontolabis gazella F. The type is a female. A male has been added at a later date, but this specimen was apparently not known to Fabricius.

Leptinopterus femoralis Oliv. The species is attributed to Fabricius in Junk's *Coleopterorum Catalogus*, but it was first described by Olivier in 1789 from Banks' specimen and the description of Fabricius (drawn from the same specimen) appeared not in 1775, as given in the catalogue, but in 1792.

Lissotes cancroides F. Boileau mentioned that he did not find this. It appears to be still the only example of its species known. It resembles *L. curvicornis* Boisd., but the thorax is more punctured at the sides, the front angles are less blunt and the lateral margins less broad and not straight.

The type of *Lucanus elaphus* F., in the general collection was also overlooked by Boileau.

Boileau also omitted to record as in the National collection the Chinese LUCANIDAE described by Saunders in 1854 (*Trans. ent. Soc. Lond.* (2) **3** : 45), of which the author says (page 46) : " All the species described in this paper are contained in the collection at the British Museum and most of them will also be found in the collection of F. J. Parry, Esq., as well as in my own collection." The fourteen supposed new species so referred to are to be found in the Museum collection with one exception, viz. *Dorcus obscurus*, Saund., the type of which seems from the figure to be a female example of *D. platymelus* Saund., with much worn fore tibiae. In searching for these specimens I found another notable exception. *Odontolabis nitidus* Saund., was not represented in the Museum. Boileau, however, recorded that he found three examples, including the type, in the Oxford Museum. The explanation is obvious. The two plates accompanying Saunders' paper were drawn by Westwood and examples of *Odontolabis nitidus* destined for the British Museum were entrusted to Westwood for drawing and, by an oversight, were never returned by him. With great generosity the Hope Department of the Oxford Museum has rectified the error after eighty years by presenting to the British Museum two of the three specimens, including that labelled as the type. Although it has not been yet found, it is probable that the missing *Dorcus obscurus* is also at Oxford.

Another hitherto unrecognised type in the British Museum collection is that of *Cladognathus marginatus* Burm. This was stated by Burmeister to be in the Museum and to have been there incorrectly named by him " *suturalis* Oliv." A specimen from the locality cited (Philippine Islands), still bearing the false ascription, is undoubtedly the type, but the species has since been quite wrongly identified. The catalogues have treated *marginalis* Burm. as synonymous with *lateralis* Hope, to which the description shows it to have no resemblance. It is in reality the same as *occipitalis*, described two years previously by Westwood (and attributed to Hope).

Calcodes Westwood.

Anyone who has made even a casual survey of a systematically arranged collection of Oriental LUCANIDAE must have been struck by the curious fact that both in *Odontolabis* and *Neolucanus*, the majority of species of which are uniformly dark, a little group occurs with pale yellow elytra decorated with an almost identical black triangle reaching from base to tip. It seems highly improbable that this pattern can have had two separate origins. If females only of *O. cuvera*, *delesserti* and *burmeisteri* and of *N. marginatus* and *parryi* had been known the close similarity of every structural feature would have led, like that of the pattern, to their being regarded as extremely closely related species of the same genus. If males of small size had also been compared, the single difference of a small projection behind the eye occurring in the first three species and not in the last two could not lead to a different conclusion, in view of the fact that an exactly similar process makes its appearance in certain species of various other Lucanid genera (e.g. *Dorcus wimberleyi*, *D. peyroni*, *Aegus acuminatus*, *Sclerognathus buckleyi*). Evidently this process has no generic significance. It is only the large males of *O. cuvera*, *delesserti*, and *burmeisteri* which suggest another category by their imposing development. The capacity for a greater range of variation, however, cannot be used for generic separation, for we have no means of judging the range of variation of species which may be known only by one or two specimens. There is no reason therefore for doubting the evidence afforded by the colour-scheme as to the close affinity of the species in question. Burmeister, in his *Handbuch*, 1847, not only treated these insects as constituting a single genus, *Anoplocnemus*, but actually regarded the forms with yellow elytra as one species. The name *Anoplocnemus*, however, although of earlier date than *Odontolabis* or *Neolucanus*, must give place to Westwood's name *Calcodes*, characterised in 1834. The type of this is *C. aeratus* Hope. *Neolucanus* was characterised by Thomson in 1862, with *baladeva* Hope for its type, and said to differ from *Calcodes* by its mandibles and its scarcely prominent prosternal process. But the second feature is unfortunately no more serviceable than the first. Not only is the prosternal process not prominent in the female of *C. aeratus*, as it is in the male, but specimens of *N. baladeva* occur in which it is sharply prominent. I have found this only in female specimens, but a male in the Genoa Museum of *N. saundersi*, a form exceedingly close to *N. baladeva*, has it very sharply produced. The impossibility of distinguishing *Neolucanus* is shown by the fact that *N. versicolor*, recently described from a female by Dr. Didier, proves, from a male since received, to have all the characteristics of *Odontolabis*.

On p. 242 of his paper mentioned above Boileau has recorded concerning *Calcodes carinatus* L. that, according to a map accompanying the series of that species in the British Museum, its range is from Ceylon, along the coast of India, to Calcutta. Leuthner, in his Monograph of the Odontolabini (*Trans. zool. Soc. Lond.*, **1885**), also mentioned specimens in the Museum collection from Madras and Calcutta. These statements are due to unfortunate errors. A specimen received by the Museum in 1882 was labelled as taken in Calcutta, but reference to the Register of that date shows this to have been a slip. The insect should have been labelled " Ceylon." The Madras record is derived from two specimens received in 1852. These formed part of a mixed collection from various parts of the world which included specimens from Ceylon. Since the species does not appear to have been found on the Indian mainland during the eighty years which have since elapsed it seems highly probable that these specimens also are from Ceylon and that *Calcodes carinatus* is confined to the island. The type of *Odontolabis cingalensis* Parry, a synonym of *carinatus*, represents the highest development of the male. Although overlooked by Boileau, it is in the Museum collection, and was labelled by Parry as his type.

Dorcus Macleay.

Lacordaire pointed out as an essential feature of this genus, the presence of a hooked tooth upon the inner lobe of the maxilla of the female. He united with *Dorcus* for that reason genera such as *Cladognathus* and *Metopodontus*, which have been separated by later authors, none of whom appear to have given any attention to the organs of the mouth. But, evidently on account of the poverty of his material, Lacordaire also united with *Dorcus* such genera as *Aegus* in which this character does not occur and which are distinguishable by external features also.

Several attempts have been made to separate from *Dorcus* other genera, *Cladognathus*, *Metopodontus*, *Prosopocoelus*, *Prismognathus*, *Eurytrachelus*, *Hemisodorcus*, etc., especially by differences in the form of the prosternum and clypeus, but, after a prolonged effort to find reasons for retaining some at least of these, I have been obliged to recognise them as mere variations of a single type, passing by gradual transitions from one to the other. The females, studied by themselves, would inevitably be regarded as belonging to a single genus and, as in *Lucanus* and *Calcodes*, the sexual dimorphism exists in every stage from the most exaggerated to one in which the two sexes are only with difficulty distinguishable. The prosternum, upon which much reliance has been placed, is peculiarly plastic and assumes a similar form in species obviously not closely related. A lateral process behind the eye, as in the genus *Calcodes*, appears also in *Dorcus* in an apparently erratic manner.

Dorcus velutinus was redescribed by Boileau as *Gnaphaloryx cinereus*, according to a specimen of the latter from the Boileau collection sent to me by Dr. Didier.

Dorcus cylindricus has been redescribed as *D. rosti* by Zang, as I have been able to ascertain by examination of the types of Zang, kindly lent to me by Dr. Walther Horn, and *D. bobi* Did., appears to me to be also this species.

D. opacipennis Zang is the same as *D. suturalis* Westw., of which the type is in the British Museum.

Dorcus histrio sp. n.

♂. Rufus, opacus, capite mandibulisque nigropiceis, pronoto flavorufo, margine toto anguste vittisque tribus longitudinalibus fuscis, scutello fusco, elytris laete flavis, sutura sat late, margine externo anguste fuscis, corpore subtus cum pedibus rufis; elongatus, pedibus gracilibus, capite quam pronoto paulo augustiore, supra subtilissime coriaceo, vix bituberculato, post oculos leviter dilatato, angulis anticis haud acutis; pronoto coriaceo, lateribus postice acute angulatis, deinde antrorsum leviter, retrorsum fortiter convergentibus, angulis posticis obtusis; elytris minute et dense punctatis, prope suturam minus dense punctatis, subnitidis; prosterno postice paulo compresso, subquadrato.

Long. (cum mandibulis) 27 mm.; (absque mand.) 20 mm.; lat. max. 8·5 mm.

S. INDIA: Coorg, Periambadi Ghat, May; Kumali Hill (*K. Govindaraj*), April.

This very well-marked species resembles *D. mohnikei* and *flavidus* Parry. In coloration it is more like the former, but it is probably more closely related to *D. flavidus*. The head, mandibles, thorax, and elytra are shaped as in that species, but the head is a little hollowed in front and without the curved carina forming its front margin in *D. flavidus*. It bears a very feeble elevation on each side, which is perhaps more distinct in larger specimens. The sides of the head are a little more strongly rounded behind the eyes and in front the canthus is a little more sharply angulate both at the anterior margin of the head and at its hinder extremity and forms a slightly concave ridge between the two angles. As in *D. flavidus*, the front angles of the thorax are strongly produced but not very acute and the hind angles are curvilinearly excised. The anterior angle of the excision is still more acute but rather less produced and the posterior angle is well marked but not sharp. The sides of the elytra are gently rounded and very feebly contracted at the shoulders, which are acutely angled.

The mandibles of the type-specimen are nearly twice as long as the head, with the basal half almost straight and the terminal half gently curved. The inner edge is almost evenly serrate from the base to about three-quarters of the length, ending in a rather strong tooth and there is a similar tooth, placed obliquely a little before the tip. The legs are slender, the front tibia with a very minutely serrate outer edge, and a few very little longer teeth, the terminal fork feebly diverging, the middle and hind tibiae without spines. The prosternal process is prominent and almost right-angled.

Dorcus henryi sp. n.

Totus niger, nitidus, elytris subopacis, rugose punctatis, subcylindricus, pedibus brevibus, capite leviter coriaceo, haud opaco, sat fortiter punctato, lateribus pone oculos dente valido utrinque munitis; pronoto medio parce et minute, lateribus fortiter et dense punctato, utroque latere paulo impresso, marginibus haud angulatis, scutello bene punctato; elytris sat dense, lateraliter et postice subrugose, punctatis; prosterno postice vix compresso aut acuto :

♂. Mandibulis robustis, brevibus, compressis, subtus medio dente valido obliquo munitis, apice coadaptatis, serratis; tibiae anticae apice paulo producto, tridentato; tarsis omnibus perbrevibus.

♂. Long. (cum mandibulis) 26 mm.; (absque mand.) 23 mm.; lat. 10 mm.

CEYLON : Pulmoddai, Trincomali district (*G. M. Henry*), August.

Entirely black, with the head and pronotum shining, except at the sides, and the elytra rugosely punctured and dull, except near the suture; subcylindrical in shape, with the legs short; the prosternal process vertical in front, not distinctly compressed or pointed.

♂. The head is lightly coriaceous, fairly strongly but not closely punctured, a little depressed in front, with the front angles rounded and a strong pointed process on each side behind the eye. The pronotum is shining, minutely and sparsely punctured, except at the sides, which are strongly and closely punctured and opaque, with a marginal depression near the middle on each side. The front angles are blunt, the lateral margins rounded and not distinctly angulate, and the hind angles completely obsolete. The scutellum is well punctured. The elytra are closely punctured, rather finely near the suture but the puncturation becoming dense and rugose towards the sides and apices. The legs are short, the front tibiae fairly slender, the extremities a little produced and minutely tridentate, the outer edge with very minute scattered teeth, the middle and hind tibiae each with a small spine near the middle, all the tarsi very short and filiform. The mandibles are short, stout and laterally compressed, each with a strong pointed tooth beneath, directed forward and inward, the extremities of the mandibles obliquely truncate, coadapted and closely serrate.

I have seen only a single male specimen, taken by Mr. Henry at light in a jungle village near the sea, about 30 miles north of Trincomali, in the dry season.

Although differing in certain well-marked details, this species is very closely related to *D. oweni* Hope and *D. pascoei* Boil., and closely resembles them in form and size. The most important difference is in the much shorter tarsi, those of the male type specimen being distinctly shorter than those of the female of *D. oweni*, in which they are much shorter than in the male.

Another important difference is found in the strong puncturation of the upper surface. In contrast to the other two species the head and thorax are shining, except at the sides, and the elytra are dull, in consequence of their subrugose puncturation. The head and mandibles have the same form as those of the two allied species, the mandibles having each a single strong process beneath, as in *D. pascoei*. The prothorax has no lateral angle.

Dorcus humilis sp. n.

Niger vel rufo-niger, femoribus rufis, tibiis 4 posterioribus intus tarsisque subtus flavo-hirtis; parvus, angustus, pronoto sat lato, postice rotundato, haud angulato; elytris elongatis, quam pronoto angustioribus;

♂. Capite pronotoque opacis, elytris nitidis, linea juxta-suturali lateribusque punctatis; mandibulis brevibus, fortiter arcuatis, bifurcatis, lobo externo acuto, interno obtuso;

♀. Corpore supra nitido, capite crebre punctato, pronoti dorso leviter, lateribus dense punctatis, elytris geminato-punctatis, lateribus crebre punctatis.

♂. Long. (cum mand.) 15–17 mm.; (absque mand.) 13·5–15·5 mm.; lat. max. 6 mm.

♀. Long. 14–15 mm. Lat. 6 mm.

N. Bengal: Gopaldhara, Rungbong Valley (*H. Stevens* and *W. K. Webb*); Pedong. Bhutan (*L. Durel*).

Black, with the femora generally dark red, the inner edge of the four posterior tibiae and the under surface of the tarsi clothed with close yellow hairs. Small, rather narrow and not very convex. The pronotum is rather broad behind and its sides are strongly and evenly rounded there, without trace of a lateral angulation or hind angle. The scutellum bears a few punctures. The sides of the elytra are nearly straight and parallel and the shoulders are acute. The prosternum is prominent behind, a little compressed and bluntly pointed. The entire outer edge of the front tibia is finely serrate, with three or four slightly larger teeth in the apical part, and the middle and hind tibiae are fairly stout. The 7th joint of the antenna is acute and the three club-joints are short.

♂. The head and pronotum are opaque, the former with scattered punctures generally confined to the sides, the latter with very fine punctures in the middle, becoming more numerous and distinct near the margins and at the sides. The head is rather broad in front, but with the front angles blunt and there is no trace of prominence behind the eyes. The epistome is transversely rectangular, with the angles blunt. The pronotum is much narrower in front than behind and the front angles are produced but blunt. The elytra are very glossy, the basal margin is rugose, the outer half finely and closely punctured anteriorly and coriaceous behind. There is a single row of punctures adjoining the suture. The middle and hind tibiae have no lateral spine. All the tarsi bear large hairy pads beneath all but the last joint. The mentum is shining and rather evenly punctured. The mandibles are very short, strongly and evenly curved, very sharply pointed, with a strong horizontal tooth above near the middle of the inner edge, bluntly rounded at the end, united by a curved line with the base and forming an acute angle with the apical half.

♀. The upper surface is very shining. The head is strongly and closely punctured, with a slight indefinite elevation on each side. The pronotum is punctured, very finely and not closely in the middle, more strongly round the margins and very closely and rugosely at the sides. The elytra bear each a juxta-sutural row and three double dorsal rows of punctures and the sides and apices are closely punctured. The mandibles are narrow, a little compressed, less strongly curved than those of the male, with an interior tooth at the lower edge and another at the upper edge. The middle and hind tibiae have each a minute lateral spine.

A male specimen acquired by M. Oberthür from the Rothschild collection is supposed to have been taken in the Khasi Hills, but the collector's name is not recorded and this locality requires confirmation.

Although the well-developed males of *Falcicornis groulti* which have been figured both by Planet and Jordan present a marked difference from those of *D. humilis*, the two species are certainly closely related. *F. groulti*, however, is lighter in colour and the male, like the female, has clearly punctured elytra, with three distinct double rows of punctures. I have not seen the female of that species, but it is described as having the pronotum very closely punctured and marked with a round pale spot on each side. The generic characters of *Falcicornis* are confined to the well-developed males and in my opinion the genus cannot be maintained.

The mandibles of the male seem to remain almost at the minimum development in the new species. It is of course possible that larger specimens than those known to me may occur, with larger mandibles, but the almost uniform size of the seven examples I have examined gives no indication of a greater development.

Dorcus nageli sp. n.

♂. Nigro-brunneus, supra toto opacus, capite pronotoque nigris, tibiis 4 posterioribus intus tarsisque subtus flavo-hirtis; elongatus, depressus, capite minute sat crebre punctato, pronoto brevi, lato, lateribus rotundatis, haud angulatis, angulis posticis etiam obsoletis, pronoti medio subtilissime haud crebre, lateribus densissime elytrisque minute et rugose punctatis, his quam prothorace multo augustioribus ; mandibulis brevissimis, acutis, intus medio dente brevi truncato munitis.

Long. (cum mand.) 17 mm.; (absque mand.) 16 mm.; lat. max. 7 mm.

ASSAM.

Brownish-black, with the elytra, lateral margins of the pronotum and the lower surface chocolate-brown, the lower surface of the tarsi and the inner edge of the four posterior femora and tibiae fringed with close-set short yellow hairs. Opaque above and not very shining beneath, depressed, rather narrow but with the prothorax broad. The sides of the latter are gently and evenly rounded, without lateral angulation, the base is very broad and the hind angle rounded. The scutellum is evenly punctured. The sides of the elytra are nearly straight and parallel and the shoulders acute. The prosternal process is short and rather bluntly pointed. The entire outer edge of the front tibia is finely serrate, with larger but rather minute sharp teeth rather widely spaced, and the middle and hind tibiae have each a well-marked lateral spine near the middle. The club of the antenna is moderately long and the 7th joint is sharply produced.

♂. The upper surface is entirely opaque, the head rather closely and evenly but not strongly or densely punctured, the pronotum with the punctures fine and not very close in the middle and becoming strong and dense at the sides. The head is flat and moderately broad, with very blunt front angles and without trace of prominence behind the eyes. The epistome is short and broad, with the front margin straight and the angles blunt. The pronotum is much broader behind than in front and the front angles are produced but not very sharp. The elytra are finely and very densely punctured, a little less densely near the base and with a smooth sub-nitid narrow sutural strip marked off by an irregularly punctured stria. The mentum is very densely clothed with erect yellow hairs. The mandibles are very short, strongly and evenly curved, very sharply pointed, with a short truncate or two-cusped horizontal tooth above, near the middle of the inner edge, united by a curved line to the base and forming an acute angle with the apical part.

Closely resembling *D. humilis*, it is distinguished at first sight by its entirely opaque upper surface. The prothorax is relatively wider and the elytra narrower than those of *D. humilis*. The tarsal fringes are shorter than in that species, the front tibiae are rather more strongly toothed and the four posterior tibiae have larger spines. The prosternal process is shorter and blunter.

Gnaphaloryx Burmeister.

Van Roon's catalogue enumerates fifteen species as belonging to this genus and five others have been added since; but nearly all these belong really to the genus *Aegus*, having the eyes completely divided, whereas the type of *Gnaphaloryx* (*G. opacus* Burm.) has them entire. Nagel (1926) has shown that this is not *taurus* F., as has been supposed and that the latter does not belong to the genus. He has given a new name, *burmeisteri*, to the form which has been known as *G. taurus*, restricting the name *opacus* to the form in which the mandibles have a tooth close to the terminal fork, or at least past the middle and not before it. This form was first mentioned by Vollenhoven (1865, *Tijds. Ent.*, **8** : 154), who described examples of it from the Moluccas and who rejected the idea that it constituted a distinct species. It was named var. *andamanus* by Kriesche (1921, *Arch. Naturges.*, **86** (A) 8 : 106), who supposed it to be peculiar to the Andaman Is. It occurs also in the Malay Peninsula and probably wherever the ordinary form is found, but, as females and small males cannot be separated, only a single species, *opacus* Burm., can be recognised. Specimens from the Moluccas commonly have the post-ocular process more produced than those from more westerly regions, but this, like other features, is very variable. *Gnaphaloryx davidis* Fairm., from Pekin, of which the Museum has acquired co-types from the Boileau collection, is a species of *Dorcus* nearly related to *D. parallelopipedus* L., but rather narrower and a little less opaque above. *Dorcus velutinus* and *cylindricus* of Thomson have also been transferred to *Gnaphaloryx*, for no other apparent reason than the occurrence of a dull greyish matter upon the surface of the body, for there is no other resemblance to the type-species.

I refer to the genus *Aegus* the following :—*dilaticollis* Parry, *ericsoni* Boil., *miles* Voll., *perforatus* Rits., *sculptipennis* Parry, *squalidus* Hope, *tricuspis* Rits., and probably *borneensis* Nagel, described from the female.

Aegus Macleay.

In reviewing the Samoan LUCANIDAE in *Insects of Samoa*, published by the British Museum in 1927, I distinguished and figured three nearly related species which I referred to the genus *Aegus*, viz. *A. upoluensis* Arr., *swalei* Arr. and *tutuilensis* Arr. The first of these had been previously identified as *Alcimus dilatatus* Fairm., and was figured by Boileau under that name. It was also figured in the same year (1913) by Zacher, who applied to it the name *Eubussea dilatata*, *Eubussea* being substituted for *Alcimus*, a name preoccupied in Diptera. As I pointed out, however, there is no sufficient reason for applying Fairmaire's name to the Samoan insect. In describing *Aegus swalei* I overlooked the fact that this species had been described under yet another generic name by Kriesche in 1921, as *Malietoa hindenburgi*. The sole distinctive feature by which the genus *Malietoa* is characterised is the upward curvature of the mandible of the male, and *Eubussea* (*Alcimus*) being at present known only by a female specimen there is no evidence whether this feature occurs in it or not. A glance at the third Samoan *Aegus*, *A. tutuilensis*, shows that it is intermediate between *Aegus upoluensis* and *Malietoa hindenburgi*, the mandible curving slightly upward. The genus *Aegus* consists of many species, of which the females are closely similar and the males, when well developed, have each a distinctive form of mandible, but these distinctions invariably disappear in small specimens and form the worst possible basis for generic divisions. In my opinion no reason has been found for retaining any of these names, *Alcimus*, *Eubussea* or *Malietoa.*

A. interruptus Macl., described as Indian (with a note of interrogation), is unidentified. The type is probably in the Macleay Museum, Sydney. That of *A. chelifer* Macl., is in the British Museum.

It was noticed by Boileau that *Aegus parryi* as described by Waterhouse was composite. Specimens of three different species were included in the described series. That taken by Wallace in Sarawak, to which the females and the large male belong, should be regarded as the true *Aegus parryi.* The Museum collection contains specimens from Sandakan, British N. Borneo, Martapura, S.E. Borneo, and from Palembang, Sumatra. A specimen of it from the last locality was described and figured by Boileau as *A. hopei* Boil. The form called by Waterhouse in his diagnosis "♂ var. *minor*" is the small phase of *A. adelphus* Thoms., subsequently described by Jacowleff as *A. pygmaeus.* The "rather smaller example" mentioned by Waterhouse as having the mandible somewhat dilated before the apex belongs to *Aegus gestroi* Boil.

Parry was undoubtedly right in considering *Aegus capitatus* Westw., identical with *A. parallelus* Hope, and *A. malabaricus* Westw., is no doubt the female of the same species, but the locality Malabar is certainly wrong. The insect appears to be common in Borneo and the Malay Peninsula, but whether "Khasi Hills," to which one of the two original specimens of *parallelus* is attributed, is correct I am uncertain. Westwood believed his *A. labilis* (from Darjeeling) to belong to the same species, but I have examined the type and found it to be distinct by the situation and oblique direction of the tooth upon the mandible, the absence of a tooth behind the base of the mandible, the puncturing of the thorax, etc. Boileau (1913, *Trans. ent. Soc. Lond.*, **1913** : 257) has assigned no adequate reason for adopting Westwood's view.

Aegus frater sp. n.

♂. Niger, supra parum nitidus, parallelus, sat elongatus, vix convexus, capite opaco, lateraliter postice fortiter punctato, margine antico profunde exciso, utrinque dentato, lateribus fere parallelis, postice haud dilatatis; pronoto sat brevi, medio nitido, leviter punctato, lateribus fortiter et crebre, extus rugose punctatis, margine antico valde trisinuato, angulis anticis productis, sat acutis, marginibus lateralibus antice fere rectis, postice regulariter rotundatis; elytris profunde striatis, intervallis planis, ad post medium crebre punctatis, punctis deinde evanescentibus, lateribus totis dense punctatis, leviter arcuatis, humeris acutis; mandibulis sat gracilibus, bene arcuatis, utraque intus basi dente obliquo truncato armata; mento postice linea profunde incisa demarcato, crebre punctato.

Long. (cum mand.) 28·5 mm.; (absque mand.) 23 mm.; lat. max. 10 mm.

Gilolo: Gamkonora, 1200 m. (*G. Heinrich*).

A single male specimen.

Nearly related to *A. platyodon* Parry, of New Guinea, and having the head and mandibles of the same curious form in the male. The mandibles are without the excision of the inner edge just in front of the basal tooth found in

A. platyodon and other related species and the upper surface is much more strongly punctured, the sides of the head and thorax bearing very coarse punctures and the median part of the latter being also punctured, although less strongly. The elytra are also closely punctured, the punctures, however, fading gradually beyond the middle. They are quite absent only from a small area near the suture behind. There is a considerable resemblance to the Bornean *Aegus* (*Xenostomus*) *punctipennis* Parry, but *A. frater* has a strong sutural line between the mentum and submentum. The mandibles are moderately long and slender and each has a strong oblique basal lobe internally, not pointed but truncate or two-cusped at the end. The sinuation of the front of the head is even deeper than in *A. platyodon.*

Aegotypus Parry.

The nomenclature of this genus is at present in some confusion. *Aegotypus trilobatus* was described by Parry from a single rather small male. He afterwards figured and described a much better developed male and a female, but the latter differs greatly from those since taken and undoubtedly belonging to the species and in my opinion represents a very distinct form. All these specimens are now in the British Museum. The large male, in addition to a well-marked tooth towards the tip of the mandible, has a raised margin to the front of the head. The name *A. lobicollis* was given by Jacowleff in 1897 to a form also showing the ridge, but with less-developed mandibles. The comparative differences mentioned by him are, in my opinion, due to the specimens being of rather smaller size than Parry's large male. In the same year Boileau described and figured, under the name *A. armatus*, a series of specimens one of which is still larger than that figured by Parry, but all of them devoid of the marginal ridge to the head. Van Roon's catalogue has treated *lobicollis* as a synonym of *armatus*, but if the cephalic ridge is a distinctive character as supposed by Boileau, the second form figured by Parry should be called *lobicollis* Jak., and *armatus* Boil., will become a synonym of *trilobatus* Parry. A specimen (from Kina Balu) of Boileau's form, derived from his collection, agrees closely with the original small male from Parry's collection, the type of the species. A good series of specimens collected by Mr. Pendlebury at Kiau, Kina Balu, show clearly that the cephalic ridge is a feature peculiar to large males, and I am inclined to believe that all the described males belong to a single species. Parry's female, however, although no doubt belonging to a related species, is certainly distinct. Having been figured, it seems desirable in the interest of clearness that it should have a name and I therefore append a short provisional diagnosis.

Aegotypus marginatus sp. n.

(1874, *Trans. ent. Soc. Lond.*, **1874** : pl. 5, fig. 5.)

Fusco-brunneus, opacus, breviter erecte flavo-setosus, parum convexus aut elongatus, pronoti et elytrorum lateribus deplanatis, longius et densius setosis, capite crebre et fortiter punctato, lateribus extus valde anguste productis : pronoto inaequaliter subrugose punctato, lateribus ad post medium fere rectis, deinde convergentibus, angulis anticis rotundatis : elytris leviter striatis, intervallis paulo convexis, minute haud crebre punctulatis : tibia antica prope medium dente minuto armato, tibiis quatuor posterioribus muticis.

Long. 11 mm.; lat. max. 5 mm.

BORNEO.

This differs from the female of *A. trilobatus* by the more sharply-produced

sides of the head, the less dense and uniform puncturation of the thorax and the sides of the latter which are not lobed but almost straight.

Torynognathus gen. n.

Corpus breve, convexum, setosum. Caput antice fortiter dilatatum. Oculi toto divisi. Epistoma late excisum, utrinque acute angulatum. Mandibulae brevissimae, latae, supra cavatae. Maxillae fere nudae, lobo interno angusto, acuto, externo majori, claviformi, palporum articulis tribus basalibus brevibus, ultimo longo. Mentum haud breve, bilobatum; ligula parva, absque lobis, palpis terminalibus, articulo basali paulo elongato, 2° brevi, 3° fusiformi. Prothorax brevis, latus, marginibus lateralibus reflexis, angulis omnibus rotundatis, basi fortiter arcuato. Scutellum latum, obtusum. Elytra striati, lateribus late marginatis, arcuatis, humeris obtusis. Prosternum haud retrorsum productum. Pedes simplices, modice graciles, femoribus angustis, tibiis extus absque spinis, anticis apice bidentatis; tarsis brevibus. Antennae breves, clava brevi, 3-articulata, articulo 7° haud producto.

Genotype: *Torynognathus oberthuri* sp. n.

Torynognathus oberthuri sp. n.

Castaneo-rufus, dorso setis fulvis erectis haud dense vestito, lateribusque totis longius fulvo-hirsutis; ovatus, convexus, nitidus, capite haud dense aut profunde punctato, lobis lateralibus latissimis, antice angulatis, extus rectis, obliquis, capitis lateribus postice convergentibus, mandibulis latissimis, conjunctim fere semicircularibus, intus fere recte truncatae; pronoto lato, fortiter sat parce punctato, angulis anticis late rotundatis, posticis obtusis, marginibus lateralibus fortiter reflexis, leviter arcuatis, basi valde arcuato; elytris paulo irregulariter punctato-striatis, striis pallide setosis, apicibus paulo productis, haud striatis, rugulosis:

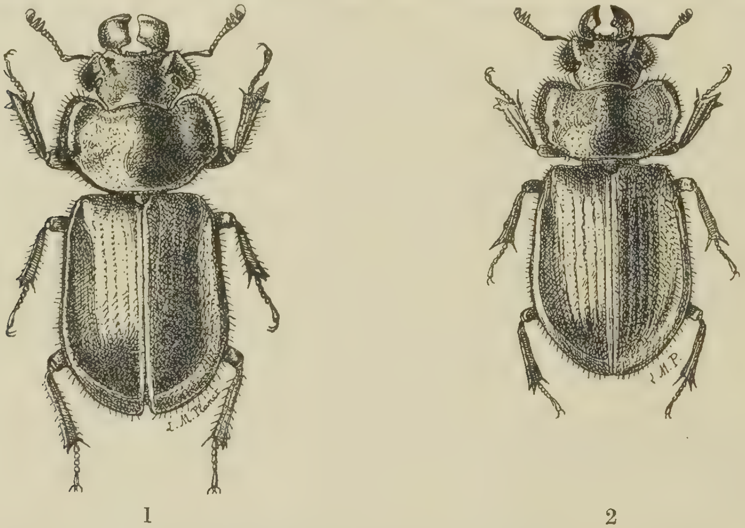


Fig. 1.—*Torynognathus oberthuri* gen. et sp. n., male; fig. 2, female.

♂. Capite latiori, mandibulis latioribus, oculisque (de super visis) minoribus.

Long. 7·5 mm.; lat. max. 3·5 mm.

Sumatra: Semangoes Forest (*J. Bouchard*).

This curious little insect has been kindly sent to me by M. René Oberthür, who received it several years ago in a collection made by the late J. Bouchard. It has so little resemblance to any other known member of the family that it

was not until recently recognised as belonging to the LUCANIDAE. It is remarkable for the apparently primitive condition of the mandibles, the dimorphism which is the most conspicuous feature of the group being here almost at its minimum. The head and mandibles of the male differ from those of the female only in being a little larger and relatively broader. The shape of the prothorax, with its broad hollowed lateral margins, obsolete angles and strongly rounded base is very peculiar. The loose articulation of this part of the body with the hinder part, and the similarly slight co-adaptation of the head and prothorax seem to indicate a partial capacity for rolling the body together. Although the genus is a rather isolated one it possesses all the essential features of the LUCANIDAE, and the divided eyes, striate elytra and the general character of the mouth organs associate it with the *Aegus* group of genera. The setose upper surface, simple unspined tibiae and rounded anterior lobes of the prothorax appear to show some degree of relationship to the genus *Aegotypus*. The organs of the mouth are reduced, although the palpi are well developed. The labium and maxillae are without the usual dense clothing of hairs and the insects are probably incapable of taking liquid food, as is the habit of other LUCANIDAE. The mandibles, greatly as they differ from those of typical male Stag-beetles, are essentially of the form found in most females and not greatly different from those of the female *Aegotypus trilobatus*, although shorter and broader.

Platyfigulus gen. n.

Depressus, elongatus, nudus, pedibus parum gracilibus. Tibiae intermediae et posticae intus et extus fimbriatae, haud spinosae. Tarsorum omnium articuli tres basales breves lati, subtus dense setosi, articulus 4 minutus, 5 gracilis. Caput latum, antice dilatatum, utrinque rotundatum. Oculi minuti, toto divisi, ab lateribus sat remoti. Antennae graciles clava triphylla brevissima. Prothorax brevis, antice latus, postice arcuatim contractus, lateribus obtuse angulatis. Elytra angusti, striati, humeris acute angulatis. Corpus subtus glabrum. Prosternum haud elevatum, postice deplanatum. Mentum breve, antice late bilobatum. Ligula longe bilobata, lobis fortiter divergentibus, antice dense ciliatis; palpis longissimis, articulo basali gracilissimo, quam duos sequentes conjunctos multo longiori. Maxillae breves, lobo interno extus uncinato, lobo externo quam longitudinem duplo latiori, apice longissime ciliato; palpis sat longis, articulo ultimo longitudine ad duos precedentes aequali.

Genotype: *Platyfigulus scorpio* sp. n.

Platyfigulus scorpio sp. n.

♂. Piceo-niger, nitidus, capite pronotoque opacis; elongatus, depressus, capite lato, fere plano, lateribus antice rotundatis, leviter reflexis, postice paulo gibbosis, haud angulatis; pronoto lato, angulis anticis productis, vix acutis, posticis nullis, lateribus vix angulatis; elytris quam prothorace angustioribus, leviter geminato-striatis, parte dorsali laevi, lateribus et apicibus crebre punctatis; mandibulis ante medium inflexis, dente parvo ante basin munitis, apicibus bilobatis.

Long. (cum mand.) 23 mm.; (absque mand.) 18 mm.; lat. max. 7 mm.

CEYLON.

The unique specimen, which has been generously presented to the British Museum by the authorities of the Colombo Museum, is of unknown origin, but must be assumed to be a native of Ceylon.

Black or pitchy-black, smooth and shining above and beneath, with the head and pronotum opaque; rather narrowly elongate. The head is broad, flat, smooth, with a few well-marked punctures behind the eye on each side. The eyes are very small, the sides of the head are a little swollen behind the eyes and the anterior part of the head is uniformly curved at the side, gently reflexed and united with the posterior lobe, widely separating the eye from the outer margin. The prothorax is short and broad, smooth and unpunctured, with the front angles produced but not very sharp, the sides gently rounded, very obtusely angulate beyond the middle and rounded to the base, without trace of hind angles. The scutellum is small and rather narrow. The elytra are narrower than the head or pronotum, rather parallel-sided, with very acute humeral angles, and each bears a strongly-impressed sutural stria and three pairs of dorsal striae, the first pair feebler than the others and all minutely punctured. The sides and apices are strongly and densely punctured. The front tibia is moderately long and bears minute irregular teeth externally. The middle and hind tibiae are rather flat, not at all slender, without lateral spines but fringed with very short close setae. The mandibles are broad at the base, strongly bent before the middle, nearly straight externally to the tip and a little dilated internally and the extremity is bilobed, the outer lobe sharply pointed and the inner lobe shorter and blunter.

Certain features of this remarkable insect, *e.g.* the completely divided eyes, the middle and hind tibiae closely fringed with setae and devoid of lateral spines and the striate elytra, are found in combination only in the genus *Aegotypus*, but in other respects and in its general shape and proportions it is so entirely different that it is obvious there is no near relationship to that genus.

Only the organs of the mouth reveal its true affinities. The chitinous hook upon the inner lobe of the maxillae of the male, the long strongly divergent lobes of the ligula and the extremely slender basal joint of the labial palpus show without doubt that it must be associated with *Figulus* and *Nigidius* in spite of its different legs and the remarkably developed mandibles. The mouth organs are rather closely similar to those of the above mentioned genera, although the labial palpi are still more slender and the last joint is very short. The ligular lobes also are broader at the base and the outer lobe of the maxilla is larger and extremely broad.

Platyfigulus scorpio is a small insect with the mandibles of the male remarkably developed for a creature of its size. They are strongly bent beyond the base and then almost straight, and there is a small internal tooth at the bend. The tips are not forked in the usual way, but a little thickened and divided in a manner curiously suggesting the pincers of a scorpion.

The short antennae, externally spined tibiae and compact, narrow tarsi of the two genera mentioned are in strong contrast to those of *Platyfigulus*. It seems unlikely that the female of the latter, like those of *Nigidius* and *Figulus*, has the mandibles similarly developed to those of the male.

The extreme flatness of the body is the feature which first strikes the eye, no doubt indicating an unusual mode of life; the three basal joints of the tarsi are also flattened, assuming a form not found in any other genus of LUCANIDAE. The sides of the head are also dilated, so that the eyes are separated by as much as their own diameter from the outer edge. The prosternum is flattened between and behind the front coxae, so that the fore legs are rather widely separated. The antennae are very slender and the three terminal joints form a club not much wider than the footstalk.

The circumstances under which the unique specimen was discovered have not been recorded and nothing is known of the habits of the insect. Its flattened form suggests that it may lurk beneath the loose bark of logs, where scorpions are also to be found. If this is so, it seems not impossible that it may have the habit of waving the mandibles in the manner of a scorpion with its chelae and that they may have an intimidating effect.

Nigidius Macleay.

The figure and description of *Nigidius validus* Péring., show without doubt that this is another name for *N. divergens* Wat., of which the type is in the Museum collection. Another specimen was identified by Boileau as *Hadronigidius bennigseni* Kr., which is also a synonym.

The type of *N. welwitschi* Wat., agrees with a specimen identified by Boileau as *N. nitidus* Thoms. The Museum specimens are a little smaller than those called *N. bubalus* Swed., but I am not satisfied that that name is not applicable to them all. *N. andamanus* Kriesche is synonymous with *N. distinctus* Parry. I have been able to compare with Parry's type a specimen from the Andaman Islands taken, like Kriesche's type, by Roepstorff. The species has been recorded by Gravely from Burma.

Nigidius rhodesianus sp. n.

Niger, nitidus, capite supra excavato, parce sat grosse punctato, mandibulis supra lobo quadrato oblique elevato armatis, capitis lateribus fere parallelis, antice oblique et acute productis, ante oculos laevissime arcuato-dilatatis, capite postice haud attenuato; pronoto medio profunde ovaliter excavato et antice acute angulato, lateribus fere parallelis, haud abbreviatis, angulis anticis vix acutis, perpaulo post marginem anticum locatis; elytris fortiter costatis, intervallis interioribus laevibus, exterioribus leviter punctatis.

Long. (mand. incl.) 11–17 mm.; lat. max. 4–6 mm.

Rhodesia: Salisbury (*G. A. K. Marshall*), Nov.; Kashitu, W. of Broken Hill (*H. C. Dollman*), Jan., Feb.

This is similar in size and general appearance to *N. laticornis* Boil., the type of which is also in the British Museum collection, but it is without the contraction of the head behind and production of the middle part of the pronotum which gives that species, in the male at least, its peculiar narrow-necked appearance. The mandibles have a broad quadrate dorsal lobe of almost the same shape. The head is similarly excavated above and coarsely and scantily punctured. It is also produced into an oblique angle on each side in front, but, instead of being narrowed from the angles to behind the eyes, the sides are almost parallel but gently dilate just in front of the eyes, at which point is the widest part of the head and not at the front angles. The pronotum is very smooth and shining, with a deep, oval median groove and retuse front margin, but the front angles are a little blunted and situated only a very little behind the front margin, with which they are united by a straight, not concave, line. Owing to the differently placed front angles, the pronotum appears to be relatively longer and narrower, and the nearly parallel lines of the sides are half as long again as those of *N. laticornis*. The elytra, as in the allied species, bear sharply elevated costae and the intervals are smooth, except those lying between the three or four outermost costae. The puncturation of the lower surface does not appreciably differ from that of *N. laticornis*.

Figulus Macleay.

It has perhaps escaped notice that the species of this genus have sometimes nine and sometimes ten joints to the antenna.

Figulus auritus, described and figured by me in 1927, *Insects of Samoa* (*British Museum*), **4**: 63, is the same as *Figulus samoanus* Kriesche (1921).

Figulus aratus sp. n.

Niger, nitidus, angustus, capite crebre rugose punctato, tuberculis tribus antice instructo, lateribus leviter arcuatis, pronoto longo, medio anguste sulcato, sulco fere biseriatim punctato, lateraliter crebre et fortiter punctato sed marginibus externis laevigatis, minutissime punctatis, angulis anticis paulo productis, rotundatis, lateribus rectis, post medium angulatis, deinde oblique approximatis, minute serratis, angulis posticis distinctis, obtusis; elytris profunde sulcatis, sulcis fortiter punctatis, interstitiis convexis, apicibus irregulariter punctatis, haud opacis; mento antice excavato, rugoso, postice laevissime punctato; abdomine subtus fortiter haud crebre punctato; antennis 9-articulatis.

Long. 8·5 mm.; lat. max. 3 mm.

S. India: Nilgiri Hills, Hattikeri (*H. L. Andrewes*), Feb. Found under bark.

Black and shining, but strongly punctured above and beneath. The head is coarsely and almost rugosely punctured and bears three tubercles placed transversely behind the front margin. The lateral margins are evenly rounded. The pronotum is long and strongly punctured on each side, but with the lateral margins smooth, and only very minutely punctured. There is a narrow median groove extending almost from front to hind margin and containing numerous large punctures. The front angles are blunt and a little produced and the sides are nearly straight to beyond the middle, where they become serrate and obliquely convergent. The hind angles are distinct but obtuse. The elytra are deeply sulcate, with the sulci closely and strongly punctured and the intervals convex. The extremities are rough but not opaque. The metasternum is smooth in the middle and strongly punctured at the sides and the last ventral sternite and the sides of the others are coarsely punctured and the middle of the latter finely. The mentum is hollowed and rugose in front and smooth behind.

Figulus acutangulus sp. n.

Niger, nitidus, modice elongatus, capite sat fortiter punctato, antice tuberculis tribus instructo, postice utrinque tumido, lateribus leviter arcuatis, angulis posticis rectis, antennis 9-articulatis, mento rugoso, utrinque excavato, postice fere laevi; pronoto parum transverso, medio profunde sulcato, sulco grosse punctato, lateribus sat grosse irregulariter punctatis sed margine laterali fere laevi, margine postice denticulato anguloque postico acuto, angulo antico paulo rotundato; elytris profunde sulcatis, intervallis angustis, costatis, sulcis crebre et fortiter seriato-punctatis, marginibus lateralibus antice denticulatis anguloque humerali acuto, apicibus rugosis, opacis; mesosterno crebre punctato, spatio utrinque laevi, metasterni medio laevi, profunde sulcato, lateribus rugosis; abdomine subtus grosse punctato.

Long. 9–10 mm.; lat. max. 3 mm.

Tonkin: Hoa-binh (*A. de Cooman*).

In general appearance and in the sculpture of the upper surface this species closely resembles *F. aratus*, but it is easily distinguished by the sharper hind angles of the head, the very distinct denticulation of the sides of the prothorax behind and those of the elytra in front, and especially by the sharp hind angles of the thorax. Another difference is to be found in the terminal spur of the front tibia. This, which is slender in *F. aratus*, is much stouter and strongly curved from base to tip in the present species.

Figulus coomani sp. n.

Niger, nitidus, sat elongatus, capite subtiliter parce punctato, tuberculis duobus anticis prope oculos duobusque posticis haud late separatis instructo, lateribus valde rotundatis, clypeo bilobato, antennis 10-articulatis, mento rugoso, utrinque excavato, linea mediana laevi; pronoto late transverso, postice medio area depressa longitudinali fortiter punctata instructo, lateribus usque ad margines crebre punctatis, angulis omnibus rotundatis, anticis paulo productis; elytris profunde sulcatis, intervallis convexis, sulcis, interioribus 2 vel 3 exceptis, crebre et fortiter punctatis, apicibus rugosis, haud opacis; mesosterno crebre punctato, spatio utrinque laevi, metasterni medio laevi, canaliculato, lateribus grosse punctatis, abdomineque subtus fortiter crebre punctato.

Long. 16 mm.; lat. max. 5·5 mm.

TONKIN: Backan (*P. Lemée*); Hoa-binh (*A. de Cooman*).

This species is to be found in the British Museum collection and in that of M. René Oberthür.

It resembles *F. cochinchinensis* and *yunnanensis* of Nagel and *F. napu* of Kriesche, but differs from them all in the strong and close puncturation of the sides of the pronotum, extending to the lateral margins, as well as the strongly punctured lower surface. It appears to be most nearly related to *F. yunnanensis*, but, in addition to the different prothoracic puncturation, it is distinguished by the shining, coarsely rugose apices of the elytra. The lower surface is strongly and closely punctured, with the exception of the pro-episterna, a small patch on each side of the mesosternum and the middle of the metasternum. The antennae are composed of ten joints.

Cardanus Westwood.

In distinguishing *Cardanus* from *Figulus* Westwood attached principal importance to the larger mentum and was in error in calling attention to the large second joint of the antenna, for this is smaller than in some species of *Figulus*. The principal distinctive features appear to me to be the narrow non-depressed shape, the simple mandibles and the broad flanges of the front femora.

Cardanus variolosus sp. n.

Niger, totus opacus, modice angustus, capite lato, vix excavato, dense sat grosse punctato. plaga antica utrinque laevi, margine antico fere recto, cantho oculari antice et postice obtusissime angulato, haud producto; pronoto toto punctato-rugoso, longitudine fere ad latitudinem aequali, medio leviter longitudinaliter impresso, tuberculo parvo nitido ante impressionem instructo, angulis anticis productis, rotundatis, lateribus minute denticulatis, antrorsum perpaulo convergentibus, post medium obtuse angulatis et deinde contractis, angulis posticis rotundatis; elytris grosse, parum profunde, seriatim variolosis, dorso utrinque inaequaliter tricostato, spatio juxtasuturali plano.

Long. (cum mand.) 15 mm.; (absque mand.) 14 mm.; lat. 5 mm.

SIAM. ASSAM: Rotung.

The type specimen from Siam in the British Museum collection was received by the late George Lewis from H. W. Bates. Another specimen, in the Calcutta Museum, was found by Dr. Stanley Kemp in rotten wood at Rotung, Assam, in December 1911.

C. variolosus is rather less narrowly elongate than *C. sulcatus* (which also occurs in Siam). The head is broader and the ocular canthus is not produced forward. The pronotum is similar to that of *C. sulcatus*, but is not longer than it is broad and is more densely punctured, with the median depression a little less deep and wide and without a smooth margin. The elytral punctures are very large and shallow and form imperfect lines, which correspond in part with shallow striae, the alternate intervals raised into fairly sharp ridges. The shoulders are very sharp but not produced forward as in *C. sulcatus*. The lower surface is entirely covered with large shallow punctures.

Dendroblax White.

Dendroblax acutangulus sp. n.

Piceus vel rufo-piceus, corpore subtus, abdominis medio excepto, fulvo-villoso; corpore supra scabroso, capite pronotoque opacis, hoc puncto minuto nitido ante medium notato, lateribus medio angulatis, postice convergentibus, angulis posticis acute productis; elytris minus opacis, rude punctatis, tricostatis; abdomine subtus medio punctato, nitido, lateribus crebre et minute rugosis, pubescentibus; antennarum articulis 2–4 plus minusve elongatis, 2 et 4 fere equalibus, 3 longiori, 5–7 descrescentibus, transversis.

Long. (mandibulis inclusis) 18–24 mm.; lat. max. 9–11 mm.

New Zealand: S. Island, Greymouth (*Helms*).

Dendroblax earlei White, the only hitherto known species of this remarkable genus appears, so far as the recorded localities indicate, to be confined to the North Island of New Zealand, the present form being its representative in the South Island. A series of five specimens taken by Helms was considered by the late David Sharp, in whose collection I found them, to belong to *D. earlei*. They are extremely similar to that species but can be easily distinguished from it by the hind angles of the prothorax being produced into a sharp spine. Other differences are so slight as to be not easily appreciable. The upper surface is on the whole a little more dull, the thorax in particular being rather more densely punctured and not at all shining, but with a very small smooth shining spot, rather rhomboidal in shape, just in front of the middle. The feeble median groove traceable in *D. earlei* is not visible in this form. The abdomen is less coarsely and more unevenly punctured, the sides closely sculptured and more thickly clothed with hair. The antennae differ slightly in the two species, those of *D. acutangulus* having joints 2 and 4 a little elongate and about equal in length, 3 rather longer and 5, 6, and 7 transverse. In *D. earlei* joints 4 to 7 are all transverse and only 2 and 3 slightly elongate.

The two sexes differ hardly at all, but the males may be distinguished by a rather greater elongation of joints 2, 3, and 4 of the antenna.

Another Lucanid from New Zealand, *Lissotes helmsi* Sharp, of which the type is in the National collection, has as a synonym *L. acmenus* Lewis. Specimens of the latter from the original locality, one of them sent by Lewis to Sharp for comparison, agree very exactly with Sharp's type.

Penichrolucanus Deyrolle.

M. Oberthür has submitted to me single specimens of two undescribed species of the extremely aberrant genus *Penichrolucanus* and as he has kindly enabled me to compare these with the type of *P. copricephalus* Deyr., the only species hitherto known of this remarkable genus, and as another species is represented in the British Museum collection I have taken the opportunity of making a comparative study of the four species. It has been questioned, according to Parry, whether the genus was rightly placed in the Lucanidae by Deyrolle, but the essential characters appear to me to fully justify his conclusion.

Penichrolucanus elongatus sp. n.

Rufo-niger, pedibus antennisque nigris; oblongus, nudus, nitidus, pedibus parum brevibus, capite late transverso, leviter ruguloso, antice emarginato et arcuatim carinato, lateribus leviter arcuatis, angulis posticis vix acutis; pronoti dorso sat aequaliter haud fortiter, lateribus fortius, partim subrugose, punctatis, lateribus leviter arcuatis, angulis

anticis fere rectis, posticis paulo obtusis; scutello angusto; elytris profunde et aequaliter striatis, striis haud punctatis, intervallis laevibus, leviter convexis; metasterni medio minute punctato, lateribus leviter striolatis; abdominis basi et apice parce punctatis; pedibus haud brevissimis, femoribus anticis latis, reliquis angustis, tibiis modice elongatis, anticis apice breviter bifidis, lateraliter minutissime dentatis, intermediis et posticis haud spinosis.

Long. 8·5 mm.; lat. 3·5 mm.

MALAY PENINSULA: Gombak Valley, Kuala Lumpur, Selangor (*H. M. Pendlebury*), Oct.

Like the other three species of *Penichrolucanus*, this is described from a single individual. It is rather larger than the other types and distinctly more elongate, with comparatively slender legs. The tarsi, although structurally identical, and with the claws concealed (with the exception of their tips), are distinctly longer than those of the other species. The tibiae, especially those of the front legs, are fairly slender, the lateral teeth in this pair are extremely minute and the tibiae of the two posterior pairs are without lateral spines. The antennal club is rather longer and the joints less unequal than in the other species. *P. elongatus* differs from its congeners also in the absence of distinct punctures upon the elytra, the striae being unpunctured and the intervals very smooth. The broad 7th interval has a short deep stria near its base (this is interrupted on one side). The colour is nearly black on the upper surface, with the sides of the head and pronotum, and the whole of the lower surface, deep red. The other three species are considerably lighter in colour.

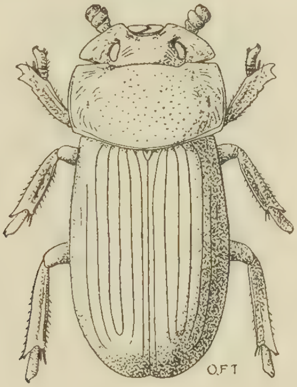


FIG. 3.—*Penichrolucanus elongatus* sp. n.

Penichrolucanus nicobaricus sp. n.

Rufus, nitidus, nudus, late oblongus, deplanatus, capite late transverso, leviter ruguloso, antice profunde emarginato et arcuatim carinato, medio bituberculato, capitis lateribus leviter arcuatis, angulis posticis acutis; pronoto parce et minute haud aequaliter punctato, lateribus antice leviter arcuatis, angulis anticis obtusis, posticis fere rectis; scutello sat angusto; elytrorum dorso fortiter striato, striis profunde sat grosse punctatis; corpore subtus laevi, lateribus leviter striolatis, segmento ultimo parce punctato; pedibus brevissimis, femoribus et tibiis latis, tibiis anticis apice bifidis, lateraliter minutissime tridentatis, intermediis et posticis haud spinosis, unguibus obsoletis vel retractis.

Long. 7·5 mm.; lat. max. 3·5 mm.

NICOBAR IS.

The type is a unique specimen in M. René Oberthür's collection. This has a very close resemblance to *P. copricephalus*, but is rather larger than that or *P. sumatrensis*. It is also relatively a little broader. The head is almost identical in form and sculpture with that of the former species. The pronotum is rather more scantily punctured and the punctures are more uneven and on the whole finer than in the type of *P. copricephalus.* The lateral margins are a little more rounded in front, making the front angles slightly blunter. The scutellum is rather narrower in the present than in the older type (perhaps only an individual difference) and the elytral striae are more deeply and coarsely punctured, the punctures more separated than in the other species. The legs are very short and broad, the front tibiae strongly bifid at the end, with three very minute, irregularly spaced lateral teeth, and the middle and hind tibiae acutely produced at the end but without lateral spines. The claws are entirely hidden between the terminal plates of the onychium. The deep anterior emargination of the head is bordered above by a nearly semicircular carina and filled by the mandibles, which do not project abruptly at the sides as in *P. sumatrensis.*

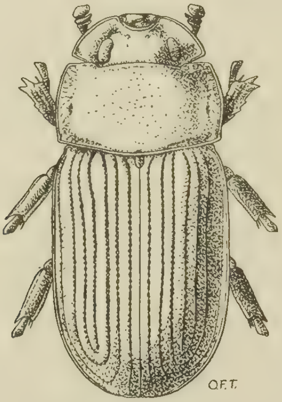


FIG. 4.—*Penichrolucanus nicobaricus* sp. n.

Penichrolucanus sumatrensis sp. n.

Totus rufus, nitidus, nudus, oblongus, deplanatus, capite valde transverso, leviter ruguloso, antice late emarginato, utrinque oblique carinato, medio bituberculato, capitis lateribus leviter arcuatis, angulis posticis fere rectis; pronoto irregulariter haud minute aut sparse punctato, lateribus fere parallelis, leviter rugulosis, angulis omnibus fere rectis, anticis perpaulo obtusis; elytris profunde punctato-striatis, lateribus laevibus, obsolete punctatis; corpore subtus laevi, lateribus leviter subvariolosis, segmento ultimo crebre punctato; pedibus sat brevibus, femoribus haud latis, tibiis paulo deplanatis, anticis dentibus 5 acutis, fere aequedistantibus, intermediis et posticis spinis minutissimis armatis.

Long. 5·5 mm.; lat. 2·5 mm.

SUMATRA: Palembang.

The unique type specimen is the property of M. René Oberthür.

Although closely similar in general appearance, this has several important points of difference from *P. copricephalus* and *nicobaricus*. The legs are relatively a little longer, the femora and tibiae less broad, the front tibiae armed with strong teeth along the outer margin and the middle and hind tibiae each bearing two minute lateral spines. The claws are perfect but partly enclosed between the large terminal plates of the onychium, the exposed extremities not divergent but lying side by side. The front of the head is nearly vertical, as in the other species, but the vertical part is not limited above by a complete carina, only an oblique ridge remaining on each side. The mandibles are larger and, the anterior emargination of the head being wider than in the other species, are more exposed and prominent. They are angulate externally, the front margin almost forming a right angle with the basal part. The exceedingly short antennae are composed of eight joints and the broad scape lies, in the position of rest, in a recess formed between the eye and the dilated submentum. The upper surface of the head is transversely striolate, as in the other species, but the two small tubercles between the eyes are rather more prominent. The shape and sculpture of the pronotum and elytra are almost the same as in *P. copricephalus*, but the anterior angles of the pronotum are a little less blunt and the punctures a little less numerous. The punctures in the elytral striae are very fine and indistinct.

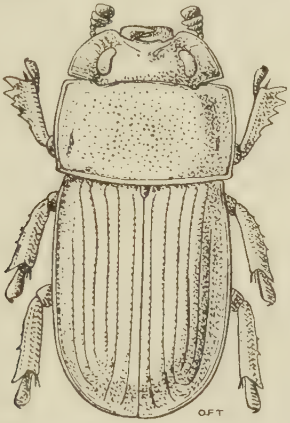
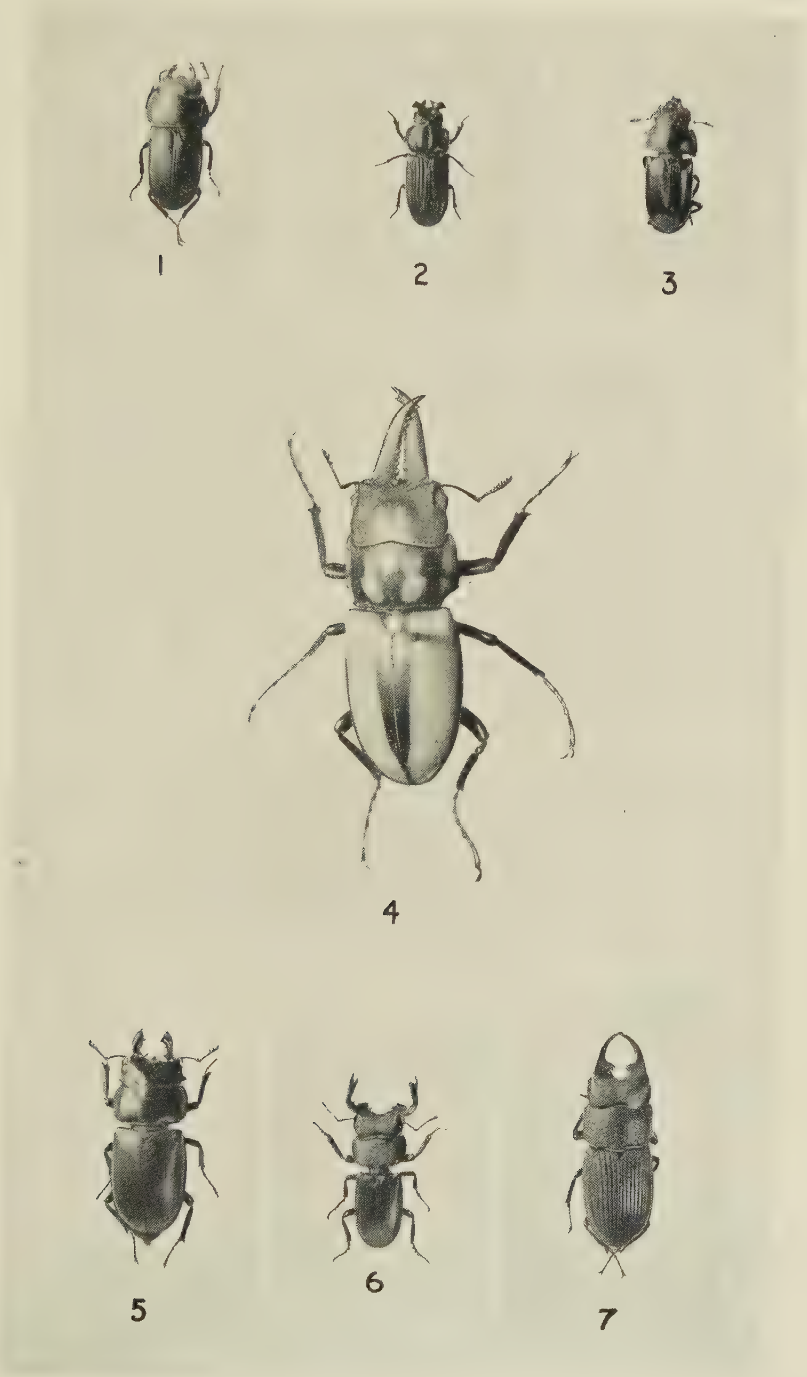


Fig. 5.—*Penichrolucanus sumatrensis* sp. n.

Explanation of Plate VI.

Fig. 1. *Dorcus nageli* sp. n. Slightly enlarged.
2. *Nigidius rhodesianus* sp. n. Natural size.
3. *Dorcus humilis* sp. n. Slightly enlarged.
4. *Dorcus histrio* sp. n. × 2.
5. *Dorcus henryi* sp. n. Natural size.
6. *Platyfigulus scorpio* gen. et sp. n. Natural size.
7. *Aegus frater* sp. n. Natural size.



The classification of Lucanids.

SUPPLEMENTARY NOTES ON THE STRUCTURAL CHARACTERISTICS OF *PYRGUS FREIJA* (WARREN, 1924) (LEP. HESPERIIDAE)

By B. C. S. Warren.

[Read 6th March, 1935.]

With Plate VII.

The late Dr. Holland, in the 1931 edition of his "Butterfly Book," refers to the insect described as *Hesperia freija* in 1924 by the present writer, as a "variety" and commented on it as follows :—

"It is based upon genitalic distinctions. Its validity is open to question. Dr. Lindsey informs me that microscopic examinations made by him have revealed that the specific distinctions relied upon by Warren are found, now on one side of the body, now on the other, in specimens of *centaureae*, which he has investigated." (Page 340, *loc. cit.*)

This statement would have been corrected long ago, but to do so necessitated photographic evidence, and as I was fully occupied with my forthcoming work on the genus *Erebia* I did not think it necessary to break in on that work in order to correct this mistake, especially as in my monograph on the genus *Hesperia* * (published in 1926) the photographs and accompanying descriptions of *H. freija* are in my view sufficient to enable *freija* and *centaureae* to be distinguished with certainty.

I fully admit that the photographs of the genitalia in my monograph were not sufficiently highly magnified; and in consequence I did not deal as clearly as would have been possible with certain features of the genitalia of *freija* and *centaureae*, for it seemed best to me at the time to confine description to details illustrated by the figures; a course I now realise to have been mistaken, and which may to a certain extent have confused Dr. Lindsey. It must be recalled, however, that the great majority of the anatomical photographs were given for the work by Prof. Reverdin; or, as in the case of that of the genitalia of *centaureae*, by Dr. Chapman; they were not selected by myself; also the lack of exact knowledge of the magnification employed by the photographers was a great drawback.

The cause of Dr. Lindsey's statement is, however, clear. In his own great work on the Hesperiids of N. America, he illustrates the genitalia by the means of outline drawings, and from his statement to Dr. Holland it is clear that in his work he also depends very largely on outline. In my forthcoming work on the genus *Erebia* I have had to deal at length with the subject of the danger of depending too much on outline drawings, which so easily become a trap to the worker, and are of scarcely any use to the reader unless he already has extensive knowledge of the structures illustrated. The present case is a most striking example of this danger, for Dr. Lindsey has actually examined specimens with a view to finding certain structural differences, and failed to observe them.

Turning to the anatomical characteristics which distinguish *centaureae* and *freija*, the shape of the cuiller varies to a certain extent in both, and it appears probable that this was the only feature examined by Dr. Lindsey. So far as my material goes, however, in spite of a certain range of variation in shape, the dorsal apex is more prominent and sharper in *freija* than *centaureae*, as shown in the figures on the accompanying plate, fig. 2 *centaureae*, figs. 3, 5 and 6 *freija*; the three of the latter showing how variation in shape does not actually affect the prominence of the apex. But connected with the formation of the dorsal ridge of the cuiller, there is a still more important difference, of unvarying constancy. The dorsal ridge in *freija*, from the apex to the point where the dorsal line may be said to pass into the distal curve of the process, is sharply serrated, the actual edge resembling a fine saw; while the whole area on each side of this serration is entirely bare of spines. Although of very perfect formation the teeth on the ridge are very fine, but they can be clearly seen in figs. 3 and 6; they are covered by the style in fig. 5. In *centaureae* the corresponding dorsal area is covered by a dense cap of spines, spreading down from the ridge on each side, and from the proximal side of the apex to nearly half-way down the distal curve of the cuiller. The actual ridge is not visible through the mass of spines. The cap of spines shows in fig. 2 as a dark mass along the dorsal ridge; owing to the curve of the surface, the spines below the level of the ridge cannot be brought into focus in the photograph, but those nearest the ridge are of equal development to those located higher up, while lower down they are reduced in size gradually.

---

* recte *Pyrgus*, Hbnr.

These characteristics of the dorsal elements of the cuiller, the serrated edge and spineless surface of *freija*, as opposed to the dense spine cap covering the ridge in *centaureae*, are entirely constant and can be relied on to identify either species with certainty; they require, however, moderately high magnification; about 80 diameters. It is scarcely necessary to add that these features prevail on both clasps.

Turning from the cuiller, one finds the supreme difference between the two species in the development of the antistyle. In *centaureae* the proximal termination of the antistyle bears a series of very strong teeth, spreading over its entire width and directed both towards the base (proximal end) of the clasp and upwards towards the harpe; here they culminate at the dorsal prominence of the antistyle in a cluster, which increases the pointed appearance of the process. This dorsal peak of the antistyle is, as I stressed in my monograph, a distinctive feature of *centaureae*. In *freija* the terminal portion of the antistyle is developed in diametrically the opposite direction to that in *centaureae*; it is directed towards the distal extremity of the clasp, being apparently folded over on itself so that the spines from its edge are directed downwards towards the ventral portion of the clasp, and backwards towards the cuiller. This terminal folded portion is clearly seen in figs. 3, 5 and 6 as a dark triangle at the end of the antistyle. This backward fold in this process is, of course, not the result of mounting the specimen, but is its natural position. If it were possible to fold down the homologous portion in *centaureae*, a somewhat, though by no means exactly, similar formation would be produced; but although a small rim of the antistyle in *centaureae* is free at the end (that is, not attached to the underlying surface) it cannot be bent over. In my monograph I described the result rather than the cause of these remarkable developments of the antistyle in *centaureae* and *freija*, stressing the blunt, rounded, proximal termination in *freija*, and the sharp, upturned point in *centaureae*; these features were obvious in the photographs which, however, did not show the developments that accounted for the formations. Having thus pointed out that the antistyle differed in these species, it is hard to understand why anyone examining the genitalia should have completely ignored the fact. Unlike the characteristics of the cuiller, the antistyle formations are most conspicuous, even under quite a low magnification; any mount could be identified by a glance with a low-power hand-lens, though to appreciate the cause of the differences a somewhat greater magnification would be required.

In referring to the " bluntly rounded " proximal edge of the antistyle in *freija*, I would point out that in figs. 3, 5 and 6, owing to pressure in mounting, the proximal edge, which is convex in nature, has been cracked and consequently made to appear a straight line; it is quite easy to mount specimens without doing this, as was the case with the specimen figured by Reverdin and reproduced in my monograph. Further, when depending on a photograph of less magnification than those accompanying this paper, the fact that the proximal edge (or false termination) in *freija* is smooth and without teeth, and the corresponding edge (or true termination) in *centaureae* covered with strong teeth, is obviously the most striking feature, and therefore the one to note.

The development of the antistyle is absolutely constant, minor variation occurs but this never has the slightest influence on the development characteristic of each species; and this is symmetrical in both clasps.

A further, less obvious difference, resulting from the specialised form of the antistyle in *freija*, lies in the subharpal plate. This plate is carried up to the termination of the antistyle in *centaureae*, but ends a little before the edge of that structure in *freija*. This can be clearly seen in figs. 3, 5 and 6 as a pale area in the background immediately before the edge of the antistyle. Could the fold in the latter be opened out, the end would lie along the edge of the subharpal plate as in *centaureae*. The presence of this gap between the antistyle and the subharpal plate in *freija* renders the formation of the antistyle all the more conspicuous.

Still two further, constant, though less pronounced differences are to be noted. First, the spines at the tip of the style are markedly longer and more numerous in *freija* than in *centaureae* (compare figs. 2, 5 and 6); and secondly, the spines with which the tenth sternite is studded in both species, are coarser in *freija* at the two sides, and less numerous, or rather more widely separated, over the whole area than in *centaureae*. Both these features require considerable magnification and are difficult to observe in many specimens, if not mounted exactly so as to display them.

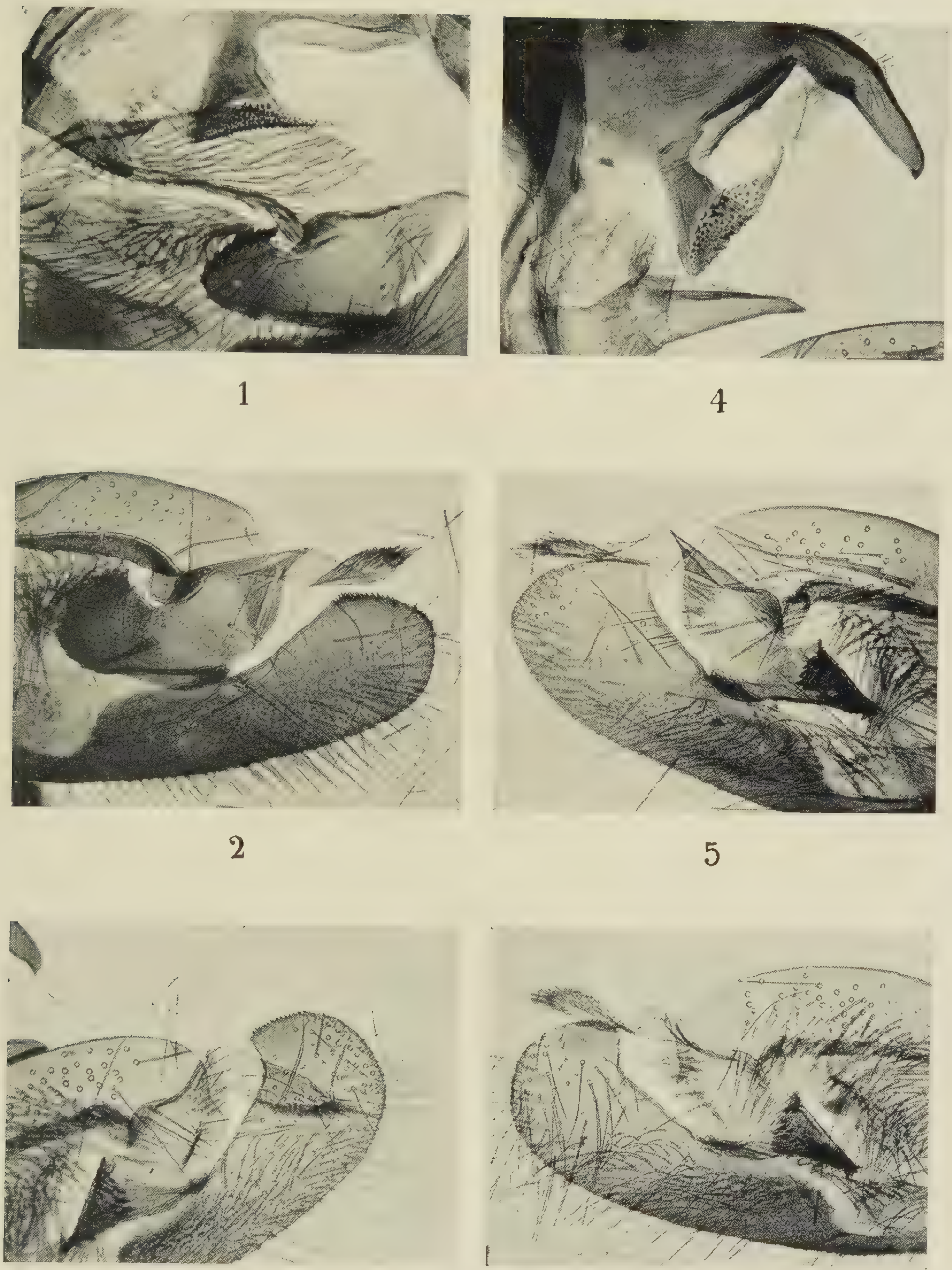
In fig. 2 the dissection was not sufficiently cleaned in preparation for mounting, and consequently the teeth of the antistyle are obscured by foreign matter; the specimen was selected because it displays the spine cap of the cuiller and the spines on the end of the style to exceptional advantage; but, one cannot stress this fact too much, that even when partially obscured, the formation of the antistyle could not possibly be mistaken for that of *freija*.

It is not necessary to refer to the superficial features of *freija* here, the figures and descriptions in my monograph being fully adequate.

EXPLANATION OF PLATE VII.

FIG. 1. *Pyrgus centaureae* (Boisduval, 1840).
2. do. do.
FIGS. 3–6. *P. freija* (Warren, 1924).

All the figures are × 48.



1 4

2 5

3 6

Structural characteristics of *Pyrgus freija* **(Warren).**

ETHOLOGICAL OBSERVATIONS ON THE CITRUS BEE, *TRIGONA SILVESTRIANA* VACHAL, AND OTHER NEOTROPICAL BEES (HYM., APOIDEA)

By J. G. Myers, Sc.D.

[Read 6th March, 1935.]

Contents.

	PAGE
(a) *Trigona silvestriana* Vachal	131
(b) *Euglossa nigrita* Lep., nest, and parasitism by *Aglae coerulea* Lep.	134
(c) Incidental observations on 44 other species	136
(d) Bee-flowers during August and September, in Santa Clara, Cuba	141
(e) Pollination of *Dioclea guianensis* (Papilionaceae)	142
Appendix—on the assembling of the Australian primitive bee, *Prosopis rollei* Ckll.	142

(1) Introduction.

The following notes, accumulated incidentally in the course of biological control work, are offered as a small contribution to our scanty knowledge of the ethology of tropical bees. With the rise of the grape-fruit industry in several of our neotropical Colonies, the Meliponid, *Trigona* (probably various spp.), is becoming a pest of increasing importance in nearly all those areas where rain-forest is being taken into cultivation, a fact which further justifies the publication of these admittedly scattered observations.

(a) Trigona silvestriana *Vachal.*

The nest.—On the 2nd of October, 1930, accompanied by Mr. Alan Pickles, I went to investigate a nest of this species on the cacao, coffee and citrus estate of Mr. Horace Rapsey, at the head of the Caura Valley, Trinidad. To both these gentlemen I am greatly indebted. The labourers are rewarded with 50 cents (2*s.* 1*d.*) for every nest which they locate in the vicinity of the cultivations. Only five had been reported in the previous nine months.

The nest in question was at the edge of the high woods (rain-forest), at an elevation of about 850 feet above sea-level, in a cacao plantation. The tree was a large hog-plum (*Spondias mombin*), about 3 feet in diameter, living and apparently sound. The nest, situated 18 feet up, showed an entrance-spout about a foot long, with an opening two inches in diameter.

The man who felled the tree wore a carnival mask, and a fire was lit at the base of the tree to carry smoke up the outside of the trunk towards the nest. The bees were not, however, very troublesome during the chopping. The tree was felled and unfortunately lay in a position which made it difficult to approach the nest. Thousands of highly excited bees poured out and attacked us, inserting themselves into every opening of our clothes, and biting sharply. Under these circumstances it was impossible for the men to saw the trunk; so we arranged to return four days later, prepared with calcium cyanide.

I was reluctant to use the latter, as I wished to rear inquilines; so we plugged the basal cavity of the trunk, the orifice of the spout and a crack in its side, with cloths and cotton soaked in chloroform. Bees began to arrive in large numbers, conspicuously laden with masses of whitish pollen and with resins. We had to light a smudge-fire to deal with these, and eventually also squirt them with a "Flit gun." Even then they attacked us rather badly, getting into our clothes and gumming our shirt-collars to our necks with the resin they dropped.

Chopping away one limb, we found that the nest was entirely external, lodged in the first fork, between two huge branches, which formed two sides of the structure. The nest was 38 inches long, oval, with a greatest diameter of about 2½ feet. The outside was covered with exceedingly hard, small-chambered resinous material, incorporated with much earth. This layer, which was apparently not inhabited by the bees themselves, was very thick at top and bottom, thinner on the exposed sides and much thinner still on the sides protected by the two branches of the fork.

Within this were the combs, arranged horizontally one above the other, connected by quite thin pillars of resinous wax (cerumen). They formed areas of wide waxy-resinous labyrinths with large (half- to three-quarters of an inch in diameter), soft, thin-walled honey-pots stuck about in them at irregular intervals. The walls of these large passages showed also occasional small waxy patches of a pale colour, looking exactly like Lecaniine Coccids, for which I at first mistook them.

The interior of the nest contained also localised areas of pollen stores, varying from reddish to pale yellow in colour. Originally the pollen had been stored in large, more or less spherical cells, but these had apparently been packed so tightly and the whole so compacted that there were now only large botryoidal masses of hard caked pollen separated by thin skins of dark wax.

When we chopped to the combs there was a loud humming like that heard in a large sea-shell, and bees in a half-dazed condition began to pour out and join the returning ones which continued to arrive and to annoy us. It was not easy to make connected observations, for the nest was so hard and large that it had to be chopped about very badly to remove it. We put into close-textured, tightly-tied soil-bags representative samples of several pounds' weight each, from (*a*) the hard, galleried top, (*b*) the inner waxy labyrinth around and above the combs, and containing the honey-pots, (*c*) the pollen masses, and (*d*) the brood-combs themselves.

The honey was very dark, fairly thin and very sweet. Litmus showed it to be extremely acid.

The soil-bags were emptied in the laboratory and the inquilines and bees carefully collected. An account of them follows, arranged according to their habitat in the nest. The specimens are all in the hands of Dr. George Salt, but it will probably be some years before determinations are available.

(I) Inhabitants of the outer, hard, earthy-resinous labyrinth, chiefly at the top of the nest:—

(1) A few large cockroaches—which probably only took refuge in the superficial galleries when disturbed from surrounding bark and debris by the chopping.

(2) Termites, nesting contiguously, if not actually interpenetrating with the bees. Their main nest, nearly as large as that of the bees, was lower and to the side, but termites were actually in the base of the bee nest.

(3) Earthen cocoon of a fossorial wasp, like *Agenia*, loose in an outer gallery.

(4) Nest of large blackish ant (*Odontomachus* sp.) with large brown cocoons, in outer labyrinth near the top of the nest.

(5) Nest of medium-sized blackish ant, with brood, actually bordering the bee-combs.

(6) Small nest of tiny ant, quite near combs, in softer part of labyrinth.

(7) A Chelifer in company with (5).

(8) An occasional Dermestid larva.

(9) A single small Lepidopterous larva in a web.

(10) Abdomen and elytra of a moderate-sized beetle.

(11) Two large, whitish grey Lepidopterous larvae in bottom labyrinth, near its waxy inner border, with frass and webbing.*

(12) A huge Stratiomyiid larva in a similar position, near the edge of the honey-pot region, where less earth was intermixed.

(13) Tiny white Psocids, very active, in the top labyrinth.

(14) Two nymphs of a flat, sluggish Lygaeid bug, near to, if not actually in, galleries of the top labyrinth inhabited by the ant (6).

(15) Fragments of a green bee, evidently *Augochlora* sp., in a cell within the more earthy portion of the labyrinth.

(II) Inhabitants of the inner waxy labyrinth around and above the combs, and containing the honey-pots :—

(16) Some small Phorid larvae at a moist spot on the wall of a wide gallery, near a pollen store.

(17) A queen bee (?) larva in a leathery cell like that in which honey is stored.

(18) Very numerous mites, crawling over everything. One very common flat species when disturbed flattened themselves tightly against the substratum and were very difficult to move (cf. the similar habit in *Termitaradus* bugs, which live with termites).

(19) Bees freshly emerged from the adjacent comb.

(III) The pollen masses :—

We brought back some four or five bags totalling about 8 lbs. of this—only a small fraction of that contained in the nest, but a larger proportion than we took of any other part, because I thought that, in these huge stores of food, with the consistency of cake and a smell of malt, would be found the most inquilines. This was a bad guess. We found no vestige of an insect, and more strange still—the mites which swarmed over the galleries and the comb itself were entirely absent, though specially searched for.

(IV) Inhabitants of the brood-combs :—

(20) Some combs contained nothing but bee pupae, of the same colour and age, others larvae, of uniform age in each comb. Nothing but bee instars were found within it.

(21) Mites were exceedingly numerous. Apparently the same spp. as in the galleries.

(22) A small, rounded, reddish beetle (*Scotocryptus* sp.).

(23) A large, freshly-emerged beetle in gallery at edge of comb, found while

---

* One of these larvae was successfully reared to a curious, reddish moth, concerning which Sir Guy Marshall, after submitting it to Mr. W. H. T. Tams, wrote that it is "*Galleria*" *rubescens* Kaye, of which only the unique type was hitherto known, but that it does not, in fact, belong to the GALLERIINAE and probably requires a new genus for its reception.

chopping. A large piece of nest-material was struck off and the beetle was seen just disappearing in a gallery. It is barely possible that it may have fallen into the nest from above. Later a tiny wingless fly was reared in some numbers from the brood-combs.

This list of inquilines, obligate or facultative, may be summed up as follows :—

Orthoptera	Blattidae	3 spp.
Psocoptera		1 sp.
Isoptera		1 ,,
Hemiptera	Lygaeidae	1 ,,
Coleoptera	*Scotocryptus*	1 ,,
	Dermestidae	1 ,,
	large beetles	2 spp.
Hymenoptera	nest of Fossore	1 sp.
	Formicidae	3 spp.
	Augochlora	1 sp.
Diptera	Phoridae	1 ,,
	Wingless fly	1 ,,
	Stratiomyiidae	1 ,,
Lepidoptera		2 spp.
Arachnida	Chelifer	1 sp.
	mites	3 spp.

Total, 24 species. This compares remarkably well with the total of 52 inquilines of Meliponid bee-nests recorded from the world (Salt, 1929, *Trans. ent. Soc. Lond.*, **77** : 431–470, pls. 20–24).

Damage to grape-fruit and other citrus.—The injury consists in the gnawing of bark from the trunk and main branches, the nipping off, wholly or partially, of young green shoots, and actual biting into the fruit. The only practicable means of control at present is the location and destruction of the nests, but the first is a difficult and the second a somewhat heavy task.

The same species was observed at Mt. St. Benedict, Trinidad, 15.xii.31, attacking large old trees (7–8 inches in diameter) of sour orange growing among cacao. They were cutting in the trunk hundreds of openings 1–2 cm. across and roughly circular. Two trees, widely separated, were thus affected. It is thus probably an old habit, not a new one originating since the recent introduction of grape-fruit culture.

(b) Euglossa nigrita *Lep.*, *nest and parasitism by* Aglae coerulea *Lep.*

The following observations began in February, 1934, at Yupukari, in the Rupununi District of British Guiana. The bees concerned were identified, through the courtesy of Mr. F. A. Squire, Supernumerary Entomologist, British Guiana, by comparison with specimens in the Department of Agriculture collection named by the Imperial Institute of Entomology.

The nest.—On the 2nd of February, in light fringe forest on the top of the high earth bank of the Rupununi River, I noticed a large beautifully metallic-green bee, buzzing loudly as it hovered outside a large, mud-encircled hole in the trunk of a small living hardwood tree of unknown species. It presently entered the hole, when attempts to dislodge it were fruitless.

I returned next day to open the cavity. The entrance-hole above mentioned was about 4 feet from the ground. It was an apparently natural, more or less irregular hole, made exactly and neatly circular by the addition of a stout clay rim, in places one-quarter of an inch in thickness, the mud rough-cast, in large pellets, without intermixture of resin. It opened directly into a spheroidal cavity about 5 inches wide and high, in more or less living tissue at the base of the dead, partly-decayed stump of a stout branch. The bottom of the cavity contained a layer of debris one inch thick consisting of pieces of decayed wood, dirt and rubbish and the remains of a dead bee. On this lay two masses of cells, and beside them an irregular moist heap, nearly one cubic inch in volume, of dark, faecal-smelling material, containing a number of fair-sized muscoid maggots. From these maggots emerged on the 14th and 15th of February, 12 specimens of a curious yellowish-grey Sarcophagid, which has not yet been determined.

Three bees were in the nest, and for a long time resisted all attempts to dislodge them by poking with a twig, only an angry buzzing being the result. Finally I cut a hole in the opposite side of the cavity, and by poking through it we eventually got them out; but one escaped in the process. The other two, which appeared exactly similar to it, were captured. They proved to be black, hairy Euglossids, *Euglossa nigrita* Lep., both females, and entirely different from the metallic-green bee of the previous day. While we were disturbing them, they had clung persistently to the masses of cells.

These consisted chiefly of barrel-shaped cells, standing upright, closely cemented together, 3 cm. high by 1·7 cm. in median diameter. Their material was a tough, hard substance, apparently consisting of clay and resin mixed. One mass consisted of 3 such cells, and the other of 8, one of which was only recently closed and evidently very new—the cap gave to the touch, as though the resin had not yet hardened. In the smaller mass, one cell had a great hole, 9 by 8 mm., eaten out of the side, and contained fragmentary exuvial remains. Another in the same mass had a similar hole, tamped, however, with a new cap, dark coloured like the new cell—evidently the old cells are thus cleaned out and used again. The big mass contained 5 such re-used cells, all with a similar hole in the side, tamped with material of slightly different colour and lightly depressed, or rather flat, in the curve of the barrel side.

Stuck less firmly to the end of each mass was a darker-coloured pot of more or less the same shape and material, a little more leathery, with more resin, perhaps; but open at the top, and shiny smooth within. These pots contained each a small quantity of apricot-coloured, extremely viscid material, apparently pollen and honey mixed into a very smooth paste, with an ill-defined flowery scent and a taste curiously like apricot. The material of the pot itself had exactly the odour of church incense. The resin of *Icica guianensis* smells like this, but is white or transparent. Perhaps they have used this mixed with other substances which have darkened it.

(2) PARASITES.

On the 20th of February, a fully formed male of a large metallic-violet Euglossid, *Aglae coerulea* Lep., had emerged from a cell, by the top, this cell having evidently not been used before. Owing probably to the too-dry conditions under which the nest was kept, the bee had died while breaking its way out. It is probable that the side holes in other cells are the exit-holes of the host-bee. Whether this violet *Aglae* is the male, and the green bee seen hovering at the entrance, the female of the same species, I do not know.

On the 2nd of March the smaller cell-mass was broken open, and the two remaining sealed cells were found empty, save for dust. Presumably the young larva had died and disintegrated, but there could have been little food. The larger mass was broken up on the 27th of April, after a male *Euglossa* had emerged. Of the remaining closed cells two were empty, lined with what appeared to be silk. The third contained a dead, dried, fully-formed pupa of *Aglae*, apparently a male, just beginning to colour.

The population of this nest thus consisted in all, of 3 female *Euglossa*, 1 male *Euglossa*, and 2 male *Aglae*, not counting what stages may have been originally in the empty closed cells.

On the Berbice savannahs, British Guiana, 25.i.33, a female of the host-bee (*E. nigrita*) was taken at the flowers of *Palicourea rigida*.

(c) *Incidental observations on* 44 *other species.*

I am indebted to Dr. George Salt, in whose collection it remains, for the determination of my material. In the Meliponidae he had the assistance of Dr. H. F. Schwarz, in the genus, *Megachile*, that of Mr. T. B. Mitchell, and in the genus *Bombus*, of Dr. T. H. Frison. Very many other species, especially from the South American mainland, remain undetermined, and are therefore not included here.

Andrenidae.

Halictus poeyi Lep.

Soledad, Cuba, 6.viii.29. At flowers of *Cassia* sp., aff. *obtusifolia.*

7.viii.29. Collected in sweeping sward of Guinea-grass (*Panicum maximum*) and *Paspalum notatum.*

9, 20, 22, 25.viii.29. At flowers of *Bidens pilosa.* Many bees, when the sky became occasionally overcast, were found in numbers coiled round the flower-stalk just beneath the ray-florets.

24.viii.29. One specimen at flowers of *Melanthera aspera* (Jacq.) L. Rich. Next day several, one of which had yellow instead of whitish pollen, and had thus evidently been collecting also at some other flower.

Small Halictine.

Mt. St. Benedict, Trinidad, 27.ii.29. I. H. Myers found under an overhanging earth-bank a company of small Halictines, clinging closely together, all head upwards, on two adjacent tangled threads of rootlets, hanging vertically and beaded with small clay concretions. One group contained 106 and the other, a few inches distant, 24 bees. They were struggling like birds about to roost, as though each wanted a place on the main thread. A few were flying. This was at 5.40 p.m. A few minutes later most were on the main threads. Six caught at random were all males, and from the general facies the rest seemed to be so too.

Augochlora sp.

Residual mixed forest, Soledad, Cienfuegos, Cuba, 17.iii.25. A large prostrate rotten log had been bored in all directions by a very large Longicorn, and was now in the possession of termites from end to end. Several specimens of this bee were found in termite galleries in the soft, moist, central part of the log, while others hovered round and finally entered the galleries, some later emerging from another exit. There was no indication of an actual nest.

Augochlora sp.

Shiriri Mountain, Rupununi savannahs, British Guiana, 11.xii.33. A deer had been shot, and was immediately cut up for transport. At once numbers of flies, ants and Meliponid bees were attracted, but these especially sought the viscera. On the other hand, many *Augochlora* bees also assembled and seemed to be attracted by the blood, which they licked up from the bespattered leaves.

Augochlora sp.

St. Augustine, Trinidad, 2.xii.28. At flowers of *Mimosa pudica.*

Augochlora cubana Ckll.

Soledad, Cuba, 22.viii.29. At flowers of *Bidens pilosa.*

Augochlora elegans Cress.

Soledad, Cuba, 25.viii.29. At flowers of *Sida carpinifolia*, and *Bidens pilosa.* Also at the latter flowers, above San Blas, Trinidad Mountains, Cuba, 15.ix.29.

Augochlora praeclara Cress.

Soledad, Cuba, 22.viii.29. At flowers of *Bidens pilosa.*

25.viii.29. At flowers of *Sida rhombifolia*, and of *Bidens pilosa.*

Augochlora regina Sm.

Soledad, Cuba, 22.viii.29. Inside flower of *Ipomoea crassicaulis* (Benth.) Robinson.

25.viii.29. At flowers of *Bidens pilosa*—also at Buenos Aires, Trinidad Mountains, Cuba, 16.ix.29.

11.x.29. Hovering round rotten log in forest.

Nomia robinsoni Cress.

Soledad, Cienfuegos, Cuba, 2.viii.29. Collected by sweeping grasses (including *Panicum barbinode*) and other ground-herbage in *guarda rayas* of cane-field.

9, 20, 22, 25, 26.viii.29. At flowers of *Bidens pilosa.* At flowers of small, pink-flowered roadside weed.

24, 25.viii.29. At flowers of *Kallstroemia maxima* in large numbers, the flowers fully opened and turned towards the sun, at 9 a.m.

At flowers of *Sida* sp. aff. *carpinifolia.*

MEGACHILIDAE.

Megachile poeyi Lep.

St. Augustine, Trinidad, 24.xi.28. At flowers of *Borreria verticillata* (L.) Meyer.

Soledad, Cuba, 20, 22, 23.viii.29. At flowers of *Bidens pilosa*, in company with other bees (*q.v.*) and *Tiphia argentipes* Cress.

Megachile beniensis Ckll.

Mt. St. Benedict, Trinidad, 18.xii.28. A male found by I. H. Myers sound asleep just before sunset (dusk coming earlier in the valley), on a twig which it gripped tightly with its mandibles, and remained so while we handled it.

Coelioxys rufipes Guer.

Soledad, Cuba, 22, 25.viii and 9.ix.29. At flowers of *Bidens pilosa.*

9.xi.29. At flowers of *Melanthera aspera.*

Coelioxys sp.

St. Augustine, Trinidad, 4.xii.28. At flowers of *Vernonia scorpioides.*

CERATINIDAE.

Ceratina cyaniventris Cress.

Soledad, Cuba, 25.viii.29. At flowers of *Sida rhombifolia.*

Trinidad Mountains (above San Blas), Cuba, 14.ix.29. At flowers of *Bidens pilosa.*

XYLOCOPIDAE.

Xylocopa sp.

St. Augustine, Trinidad, 4.xii.28. Very frequent at flowers of *Crotalaria juncea.*

Xylocopa sp.

Etang Saumâtre, Haiti, 30.i.29. At flowers of *Cassia alata.*

NOMADIDAE.

Nomada tibialis Cress.

Soledad, Cuba, 22.viii.29. At flowers of *Bidens pilosa.*

Nomada cubensis Cress.

Soledad, Cuba, 25.viii.29. Male at flowers of *Bidens pilosa.*

MELECTIDAE.

Melissa rufipes Perty.

Above San Blas, Trinidad Mts., Cuba, 18.ix.29. Hovering over pasture, 1300 feet.

ANTHOPHORIDAE.

Anthophora tricolor F.

Frigate Bay, St. Kitts, B.W.I., 5.iv.30.

On the thin pasture, a dead herbaceous weed was the sleeping place (about 5.30 p.m.) of about a dozen bees, of which two caught were males. They were just settling down for the night on two adjacent stems, which they grasped firmly with the mandibles. There were reddish and greyish forms; so probably both sexes were present.

Anthophora sp.

Long Island, Antigua, B.W.I., 23.iii.33. Several at flowers of *Bougainvillea spectabilis.*

Centris longimana F.

Kaaimanston, Coppename River, Dutch Guiana, 26.v.29. Six or more congregating on a glazed earthenware jar lying in a dug-out at the landing. They were laying their long tongues assiduously along a part of the rim, where the glaze was chipped, and were licking vigorously; but I could not ascertain the reason.

The same species on succeeding days, hovering round the heads of myself and the Bush-negro paddlers. Perhaps attracted by perspiration.

Centris smithiana Friese.

Long Stretch, Trinidad, 27.i.29. Hovering for a long period, with much buzzing, over an unusually large *Atta* mound, or rather collection of mounds, in mixed rain-forest. Another specimen occasionally joined it.

Centris poecilă Lep.

2500 feet, Buenos Aires, Trinidad Mountains, Cuba, 15.ix.29. Male hovering over grasses, 1300 feet.

Centris derasa Lep.

Mausica savannah, Trinidad, edge of rain-forest, 29.x.30. This huge bee hovering closely round a termite-nest (*Eutermes*, carton type) about 13 feet up in the palm, *Maximiliania regia*, clasped by a tree of *Clusia*. No burrows were found.

Centris personata Smith.

Cumaka, North-west District, British Guiana, 16.ii.31. Playing in couples, with exceedingly swift, dashing flight, round the stelling at the water-side. Two caught were males. This habit of *Centris* spp. of hovering round wharfs and boats is well known, but not fully explained.

Centris inermis Friese.

Mt. St. Benedict, Trinidad, 6.v.31. Several at flowers of *Byrsonima crassifolia*.

Centris sp. aff. *versicolor*.

St. Lucia, B.W.I., 23.iv.31. At flowers of *Securidaca volubilis*, very shy, swift and difficult to catch. In upland rain-forest.

Centris sp.

Mt. St. Benedict, Trinidad. A female boring into the side of a small occupied carton termite-mound, in low tree. The hole was about deep enough to receive its body when we caught it for determination, and a few days later the hole had been plastered up by the termites.

Melissodes mimica Cress.

Soledad, Cuba, 20, 22, 24, 25, 30.viii.29. At flowers of *Bidens pilosa*.

Melissodes pullata Cress.

Soledad, Cuba, 30.viii.29. Very rare at flowers of *Bidens pilosa*.

Melissodes lanieri Lep.

Soledad, 24, 27.viii.29. At flowers of *Kallstroemia maxima* (L.) Torr., in large numbers.

11.x.29. At flowers of undetermined pink-flowered roadside weed.

Exomalopsis pulchella Cress.

Soledad, Cuba, 22, 25.viii.29. At flowers of *Bidens pilosa*.

24.viii.29. At flowers of *Kallstroemia maxima*, in large numbers.

25.viii.29. At flowers of *Sida rhombifolia*.

27.viii.29. At flowers of a large Euphorbiaceous cane-field weed, and at those of *Sida* sp.

EUGLOSSIDAE.

Euglossa cordata Linn.

Ocumare de la Costa, Venezuela, 15.xii.30. Hovering like a *Volucella obesa*, for which I at first mistook it, but it has a louder buzz.

Euglossa dimidiata F.

Mabaruma, North-west District, British Guiana, 15.ii.31. Male captured with two bright yellow pollinia on dorsum, about 6 mm. long.

Euglossa fasciata Lep.

Wanaina, north-west District, British Guiana, 7.iii.31. At flowers of *Heliconia bihai*, in rain-forest. Very heavily laden with sticky pollen. The same flowers are frequented by the Balisier humming-bird (*Glaucis hirsuta*), and by a small green species which the latter repeatedly chased away.

The bee settles in the large, boat-like bract, red, edged with green, and clasps the long green flower with the first and second pairs of legs, then leisurely inserts the long tongue and probes several times. In withdrawing this very long tongue it has often to loose the grip with the front feet, and retain it only with the middle pair, these being stretched to the utmost. Three species of metallic-green bees, probably *Euglossa*, also frequent these flowers, but I have never succeeded in catching one. The same applies to a large and magnificent violet bee which flies with a curious rattling buzz.

Mabaruma, North-west District, 16.iii.31. At flowers of *Heliconia bihai*.

Euglossa bicolor Ducke (det. Brit. Mus.).

Upper Ireng River, British Guiana, 31.x.33. This magnificent metallic small species, with deep violet thorax and purple abdomen with a green tip, was found in some numbers at the flowers of an Aroid, *Spathiphyllum* sp., which is sweetly fragrant (probably only up to noon, like *S. cannaefolium* in Trinidad). The bees were hovering like Syrphids round the flower, about the middle of the morning. One bore two pale yellow oval pollinia plastered symmetrically on the dorsum of the abdomen.

BOMBIDAE.

Bombus atratus (Franklin).

Caracas, Venezuela, 4.xii.30. At flowers of bean, planted in alternate rows with sugar-cane.

21.xii.30. Not uncommon on the lower grass-slopes of La Silla, Caracas.

Bombus robustus (F. Sm.).

La Silla, Caracas, Venezuela, 21.xii.30. Collected in upper-edge of cloud-forest, at an elevation of about 2200 m.

Bombus incarum Franklin.

Mabaruma, North-west District, British Guiana, 15.ii.31. At flowers of cotton (*Gossypium*) 12.ii.31. At flowers of a pale purple, very prickly (recurved thorns) shrubby *Solanum*. 6.ii.31, on the same flowers at Wanaina. Also visits the flowers of *Solanum* sp., aff. *torvum*.

Mabaruma, 8.iii.31. A nest was found high up on a bank, in rain-forest. It consisted of a large mound containing at least two bushels of cut-up dead leaf debris, with a wide shelf-like opening in the side, disclosing almost a comb of large honey-pots stuck together, each considerably larger than the bee itself. I could not see farther in. There was a crowd of bees on the shelf, at the entrance and on the honey-pots. Every now and again two would engage in a combat, clasping each other and rolling over and over on the ground. I tried to catch one which was being obviously chased away from the opening, but the whole company surged out aggressively and I received a very painful sting.

Wanaina, 13.iii.31. From the number of huge solitary females one sees buzzing closely round earthen banks and roadsides, where there are no flowers, this must be the time for the founding of new colonies, it is about the middle of the short dry season.

Wanaina, 10.iii.31. Taken inside the huge and fragrant flower of a *Lecythis* sp. growing as a small sapling in rain-forest.

Apidae.

Apis mellifica L.

Soledad, Cuba, 24.viii.29. At flowers of *Kallstroemia maxima* in large numbers. The yellow form was at least four times as numerous as the black.

St. Lucia, B.W.I., 23.iv.31. At flowers of *Securidaca volubilis* in upland rain-forest.

Tunapuna, Trinidad, 24.xii.28. A specimen 13 mm. long (excluding wings) taken by a green Thomisid spider only 6 mm. long, on flowers of an undetermined composite.

St. Augustine, Trinidad, 2.xii.28. At flowers of *Mimosa pudica.*

Exposed combs.—At Croix de Bouquets, Haiti, I was surprised to see a colony of the hive-bee, under the open house-verandah, fully exposed to the prevailing wind, which caused the long thin combs to shiver constantly. There were eight of these large triangular combs, hanging vertically, apex down, the biggest nearly 3 feet long by 2 feet wide. The owner of the house said he had twice fastened boxes up near the combs, but the bees had refused to occupy them. There is a fine photograph by P. Rau, of an exposed comb, in 1931, *Ecology*, **12** : 615.

Melipona fulvipes Guer.

Hacienda Jiqui, Ensenada de Cochinos, Cuba, 5.x.29. Nesting in hollow trees of *Bursera simaruba* coastal forest. The charcoal-burners cut out the logs and brought them to their hut, where, from time to time, they roughly extracted a black and sticky mess of wax and honey, which tasted of flowers. The bees seemed to flourish in their new surroundings. A sentry was always posted at the circular, wax-lined entrance to the nest.

Trigona spp. (sweat-bees).

Tiny bees of this genus are an almost unbearable pest during the day, in some of the Rio Branco and Rupununi savannahs of Brazil and British Guiana. They are fortunately local in distribution, usually found just outside the edge of the dry forest which clothes the base of some of the isolated mountains. They fly with exasperating directness to one's eyes, and without closing these completely it is impossible to keep them out.

(d) *Bee-flowers during August and September, in Santa Clara Province, Cuba.*

An analysis of the records shows that by far the most popular bee flower was the composite weed, *Bidens pilosa.* Not only did it receive the visits of thirteen species, but these were always in considerable numbers. *Sida rhombifolia* and *Kallstroemia maxima* come next, with three species each, *Sida carpinifolia* and *Melanthera aspera*, with two species, and *Ipomoea crassicaulis* with one.

(e) *Pollination of* Dioclea guianensis (*Papilionaceae*).

On the edge of a bush island on the Rupununi savannahs, near El Algodon (British Guiana), a large, purple-flowering mass of this vine was visited by numbers of bees and skippers. The bees were chiefly a large *Xylocopa*, and a slenderer form, nearly as long as the former, of a metallic greenish-black, with black wings and very long, broad hind legs. This latter species is unfortunately still without a name. The manner of approaching the flowers was strikingly different in the two bees. *Xylocopa* approached anyhow, and by brute force thrust its great head into the flower. The slenderer bee, on the other hand, always alighted exactly in one way, clasping the flower directly from the front, so that the long third pair of legs lay along the wings of the flower, the abdomen along the keel and the front legs on the standard. It then pushed steadily apart the standard from the keel and wings, and inserted its tongue into the now gaping flower.

The skippers, *Megathymus* sp., alighted delicately, and insinuated only the long thin proboscis, gradually working it into the depths of the flower.

Appendix.—Assembling of the Australian bee, Prosopis rollei *Ckll.*

At Renmark, South Australia, on 26th February, 1927, I found an extraordinary gathering of this species (determined by Waterston and Turner) round a small dead limb supported by its branches some four feet from the ground. A large number of the bees were flying round the free end of the log, piping shrilly. Beneath the loose bark were closely-packed masses—wherever a bee could possibly squeeze in, lying absolutely inert and to all appearance dead. They remained thus, either on the log itself or in crevices on the underside of the removed bark, even when completely exposed to the light—strong sunlight—and moved only when the sides of the crevice were broken. They then ran and took flight with great rapidity. They remained quiet as long as any possibility of thigmotropic stimulus was present. There were no signs of burrows, nest or food. Those disturbed hovered round for a while and then crawled in again to a convenient crevice and remained quiet as soon as they were sufficiently squeezed in.

NOTES ON THE NOMENCLATURE OF THE ACULEATE HYMENOPTERA, WITH SPECIAL REFERENCE TO BRITISH GENERA AND SPECIES

By O. W. Richards, M.A., D.Sc.

[Read 1st May, 1935.]

The following notes have been prepared with a view to the publication of a revised list of the British Aculeate Hymenoptera. The generic and specific names of this group have never, as a whole, received a thorough revision according to the International Rules of Nomenclature. Further, a number of old types have not recently been re-examined. It is therefore hardly surprising that a rather large number of nomenclatorial changes are brought forward. The greatest care has been taken to insure that references, dates, type-citations, etc., are correct, and it is hoped the prospect of some degree of stability in nomenclature (founded on an intensive study of the literature) may compensate for the prospect of immediate change.

It is a pleasure to record the help I have received from numerous colleagues. The bibliographical side of the work has greatly benefited and in a number of cases has actually been carried out by Mr. F. J. Griffin, whose wide knowledge of Entomological literature has been of the greatest aid. Mr. R. B. Benson has kindly put the facilities of the Hymenoptera Room of the British Museum freely at my disposal. Mr. N. D. Riley kindly negotiated with various institutions for the loan of types to the British Museum (Natural History); through him certain types have been sent by Baron K. von Rosen (München), Dr. O. Schröder (Kiel), Dr. N. A. Kemner (Lund), and Mons. A. Ball (Bruxelles). A loan of some Haliday types was arranged by Mr. A. W. Stelfox, of Westwood and Cameron types by Prof. G. D. H. Carpenter and of some Chitty types by Mr. Claude Morley. Mons. L. Berland kindly compared a specimen with a Kieffer type at Paris and also reported on certain types which were or might have been in the Museum national d'Histoire naturelle. Dr. F. Maidl showed equal kindness to a request with regard to types in the Naturhistorisches Museum, Wien, and Prof. Dr. H. Bischoff with regard to types at the Zoologisches Museum der Universität, Berlin. Dr. P. Blüthgen was good enough to explain to me his views on the complicated synonymy of the genus *Pemphredon* s.l., and Prof. T. D. A. Cockerell gave me some information as to type-fixation of certain bee-genera. Finally, Mr. A. Savage gave me every aid in examining Linnaeus' collection and Kirby's correspondence at the Linnean Society. I wish to record my best thanks for all this invaluable co-operation.

The notes that follow are numbered consecutively to facilitate reference.

1. The Linnean types in the collection at the Linnean Society, Burlington House.

Few of the specimens in Linnaeus' collection can be regarded as types in the modern sense of the word. Linnaeus himself probably often discarded specimens, added them to his series and exchanged labels. The subsequent owners * of the collections certainly took an equal liberty. A number of specimens included in the collection were certainly added after the collection came to England, *e.g.* many of Kirby's species of bees. In the most favourable circumstances, a Linnean " type " is a specimen agreeing with the original description and bearing a label in Linnaeus' handwriting. Some specimens with such labels, however, disagree with the original descriptions. A considerable latitude can, therefore, be allowed in deciding what to regard as types, so as to necessitate the least number of nomenclatorial changes.

2. The date of J. C. Fabricius " Systema Piezatorum."

The following note is based on the research of Mr. F. J. Griffin. Fabricius' work is usually supposed to have been published at Brunswick in 1804. The preface is dated 10th March, 1804, which gives the earliest date possible for publication. The copy of the book in the library of the Royal Entomological Society of London has certain advertisements bound in at the end which are part of the original book and have not been added later by the binder. Amongst the works advertised therein is Meigen, J. W., 1804. " Klassifikation und Beschreibung der europäischen zweiflügeligen Insekten." This was published late in 1804. In the advertisements at the end of Meigen's book, the " Systema Piezatorum " is advertised but no price is given, whereas with works which had already appeared the price is indicated. In the advertisements at the end of the " Systema " is furthermore one of the 4th Band of Illiger's Mag. f. Insektenkunde which was published 1805. This advertisement gives the price of the 4th Band which must have appeared already. There is little doubt that the " Systema " was really published early in 1805; in any case it post dates Vol. 24 of the Nouveau Dictionnaire d'Histoire naturelle (March, 1804).

The following genera and species (the modern genus being placed in brackets) should be dated from 1805.

Dryinus Fab. *nec* Latreille (1804), [*Chlorion*]; *Bethylus depressus* [*Pristocera*]; *Lasius* Fab. *nec* Jurine and Panzer; *Salius*; *Trypoxylon equestre* [*Mimesa*]; *Trypoxylon atratum* [*Psenulus*]; *Crabro continuus* [*Solenius*]; *Mellinus quadrifasciatus* [*Hoplisus*]; *Prosopis*; *Megilla labiata* [*Macropis*]; *Anthidium*.

DRYINIDAE.

A large number of the types in this family have been accessible. Many of Kieffer's types are in the Cameron collection in the British Museum. The Westwood types are at Oxford. The Chitty types are in the collection of Mr. Claude Morley. The Walker–Haliday types are divided between the British Museum and the National Museum of Ireland, Dublin. Mr. A. W. Stelfox of the latter Museum has given me invaluable assistance in studying the specimens under his care and only with his co-operation has it been possible to discover which specimens actually are the types.

The Walker–Haliday specimens of DRYINIDAE are now divided amongst five different series of specimens.

---

* In the Kirby Correspondence in the Linnean Society's Archives is a letter to G. A. McLeay, Esq., dated June 10th, 1801. He writes, " The *Bembex rostrata* [just received from Latreille] varies somewhat from the authentic specimen of the Linnean cabinet (which *entre nous* being mutilated Dr. Smith gave me placing another in its situation), but I believe it is only a sexual variety, as my specimen is a male; and M. Latreille's a female."

A. British Museum (Natural History), London,

(1) Specimens with the registration number 1904–120. These are Walker " types " bought first by the Rev. A. Matthews, then by Dr. P. B. Mason, then by Rev. T. A. Marshall, from whose collection they passed to the British Museum. Until they were incorporated in the Museum collection, they had been kept in the original box in the same arrangement as Walker left them.

(2) Specimens with registration numbers 38.4.5 (1–19). These specimens were incorporated by Walker in the Museum collection in 1838, a short time after his paper on the DRYINIDAE appeared (1837).

B. National Museum of Ireland, Dublin.

(3) A box forming part of the Haliday collection. The specimens were apparently of Walker's collecting and mounting and stand above printed labels cut out of some old list.

(4) A box forming part of the Haliday collection. The specimens were apparently collected and mounted by Haliday, but stand over manuscript labels in Walker's handwriting.

(5) A box of unarranged specimens in the Haliday collection.

One specimen in (5), however, bears Haliday's mss. label. The above numbers will be used to indicate the present location of types. In deciding which specimens are types, the first consideration is that the types of species described by Haliday or by Haliday *in* Curtis are in collections 3 or 4. The types of specimens described by Walker with the addition " Haliday mss." are in the Haliday collection. The types of species described solely by Walker are mostly in the British Museum collection. There are no holotypes, but by careful study of the descriptions it is often possible to find one specimen out of the series which best agrees with the description. In the present communication, I propose only to redescribe species where this is essential for their recognition.

3. *Laberius vitripennis* (Haliday, 1833).

Mr. Stelfox told me that the type of *Labeo vitripennis* Haliday still exists in the Haliday collection (4) at Dublin. The genus is made up of males only, which are probably those of *Dicondylus* or *Gonatopus*.

4. *Gonatopus oratorius* Westwood, 1833.

Prof. G. D. H. Carpenter kindly allowed me to examine the type of this species, now preserved at Oxford. The following redescription will assist in its recognition.

♀. Light red. Abdomen black. Vertex darkened, especially posteriorly. Antennae with at least three first segments light yellow and about seven apical segments black. L. 2·75 mm.

Vertex a little dull and alutaceous, central keel almost obsolete. Antennae with first segment curved, more than twice as long as broad, not very thick; second segment almost as thick, twice as long as broad, two-thirds as long as first; third segment very thin, considerably shorter than 1 + 2 together; subapical segments about one and a half times as long as broad; antennae little thickened apically. Pronotum in dorsal view pear-shaped, broadest well in front of middle but only moderately narrowed posteriorly; in profile very slightly curved, very little raised, no transverse or longitudinal impressions, smooth and shining. Posterior part of thorax bare, transversely striate except for a small discal area between the spiracles; more than twice as long as broad, in dorsal view considerably broadened from narrow anterior stalk, in profile gently raised in a smooth curve, posterior declivous face very oblique. Abdomen smooth and shining. Fore femora moderately thickened, about twice as thick as thickest part of tibia; tarsi very much covered by gum, first segment as long as segments 3 + 4, more than twice as long as 2 + 3; enlarged claw straight with a small apical part a little curved, without subapical tooth, probably without lamellae; fifth segment (other part of forceps) thin and straight, not suddenly becoming thinner before apex, apical part only a little incurved; lamellae probably on apical part and along greater basal part of straight basal section.

The type bears no data but the name in mss. and two numbers " 31 " and " R.26."

5. *Gonatopus ljunghii* Westwood, 1833.

The type of this species is also preserved at Oxford; the following is a redescription.

♀. Black. Clypeus, small mark above antennae, short lines along orbits above antennae, antennae (except somewhat darker apical part), legs except thickened part of fore femora and hind coxae, yellowish. Fore tibiae a little darkened posteriorly. L. 3 mm.

Vertex shining with fine central line practically obsolete. Antennae with first segment rather thick, a little bent, twice as long as broad; second segment two-thirds as long as first, thin, twice as long as broad; third segment very long and thin, distinctly longer than 1 + 2, as long as 4 + 5; segments 8 and 9 about one and a half times as long as broad; antennae only feebly thickened apically. Pronotum in dorsal view broadest at about middle, lateral margin subcircular; in profile rising regularly from anterior margin for three-quarters of its length, then sinking abruptly to posterior margin, the two faces almost at right angles; posterior part of thorax about twice as long as broad, dull, weakly coriaceous, bare. Abdomen and pronotum smooth and strongly shining. Fore femora very thick, two and a half times as thick as thick part of tibia; first tarsal segment rather more than twice as long as segments 2 + 3, rather longer than 4; enlarged claw without subapical tooth or lamellae, gently curved; fifth segment (other part of forceps) straight, becoming abruptly thinner just before apex and beyond this strongly curved, curved apical part bearing about five lamellae, straight basal part bearing a row of about fifteen short bristles.

The type is a female labelled " Wimbledon " and with a short mss. note on its method of shamming death and on its relationship to *D. formicarius* Dalman.

6. *Gonatopus sepsoides* Westwood, 1833.

Two specimens of this species are preserved at Oxford. One labelled " Black Gang Chine, Aug. 1831 " is without the head and fore legs. The other bears no data, but is in good condition and may be regarded as the type. The following is a redescription.

♀. Black. Head except in neighbourhood of ocelli, antennae 1–2, dorsal spot on pronotum, mark on first tergite, legs (except fore femora which are brown) yellowish testaceous. L. 2·5 mm.

Vertex with a fine central line. Antennae exactly as in Kieffer's description of *sociabilis* (1914, *Das Tierreich, Bethylidae*, **41**: 108). Pronotum in dorsal view broadest well in front of middle and considerably narrowed posteriorly; in profile with anterior third a little lower than posterior two-thirds, which is flat. Posterior part of thorax with outstanding hairs, declivous face transversely striate; thorax otherwise smooth and shining. Fore legs with enlarged claw without teeth or lamellae, apex a little bent; fifth segment of tarsi (other part of forceps) straight with small apical part strongly bent and bearing about five lamellae, segment otherwise only with a row of about 15 fine bristles. Close to *sociabilis*, but in Kieffer's key would run down to *G. ljunghii*.

The type of *G. sociabilis* Kieffer is in Mr. Donisthorpe's collection of myrmecophiles and he has kindly allowed me to examine it (the head is now missing). *G. sociabilis* has chelae as described by Kieffer (not as described above); prothorax entirely black; pronotum posteriorly in profile more angularly and deeply declivous; disc of propodeum more shining; length 3 mm.

7. *Dicondylus* Curtis, 1829–30.

There has been some confusion between two British species of this genus. *D. bicolor* (Haliday *in* Curtis, 1828) and *D. striatus* (Kieffer, 1905) (= *D. pedestris* Haliday, ? of Dalman). Mr. A. W. Stelfox, in correspondence, has indicated what is probably the source of the confusion and also enabled me to examine Haliday's specimens.

The genus *Dicondylus* was validated by Curtis (1829–30, *Guide to an Arrangement Brit. Ins.* : 110) since he published the name and cited two described species, viz. *D. bicolor* and *D. pedestris*. Of these, Kieffer (1914, *Das Tierreich, Bethylidae*, **41** : 73) cited *D. bicolor* as the type.

Dryinus bicolor Haliday *in* Curtis (1828, *Brit. Ent.* : 206) (type in coll. 4) is stated by Curtis to have been found " in moss on a bank in Ireland." Haliday (1833, *Ent. Mag.*, **1** : 273) in his diagnosis of *Dicondylus*, cites only a single species, viz. what he calls *D. pedestris* Dalman. Probably by this date he had persuaded himself, or Walker had persuaded him, that *D. bicolor* was only a colour variety of that species. Walker (1837, *Ent. Mag.*, **4** : 412) takes this view, his var. δ of *pedestris* being *D. bicolor*.

Haliday (1835, *Ent. Mag.*, **2** : 221) says of " *D. pedestris*," " The first time I met this species . . . was near Darent Wood." Later, " In this island [*i.e.* Ireland], its haunts are sandhills. . . ." Walker (1837, *loc. cit.*), on the other hand, records his " *pedestris* " only from Kent (Haliday) and Jersey. His figure (*loc. cit.*, pl. xvi, fig. 5) is of a " *pedestris* " (*i.e. striatus*) which must have come from Ireland. It is highly probable that the original specimen of *D. bicolor* was from Darent Wood and that Curtis supposed that it came from Ireland, like most of Haliday's insects.

With this assumption, the distribution of these insects becomes rational.

(1) *D. bicolor* (Haliday *in* Curtis). Woodland species, recorded from :—W. Kent (Haliday), Bucks and Berks (Richards, 1933, *J. ent. Soc. S. Engl.*, **1** : 51), ?S. Hants (Donisthorpe, 1927, *Guests Brit. Ants* : 102).

(2) *D. striatus* (Kieffer) (= *pedestris* Haliday). Sandhill species, recorded from :—Co. Down (Haliday), E. Kent, Deal (Donisthorpe, *loc. cit.* : 103).

Gonatopus pedestris Dalman, 1818 must await examination of the type before the name is used. Kieffer places it in the genus *Platygonatopus*.

8. *Dryinus sisythrus* Walker, 1837.

The type is a female in collection 2. It is the same as *Anteon crenulatum* Kieffer, 1905 (compared with type), *Anteon scoticum* Kieffer, 1905 and *Anteon vicinum* Kieffer, 1905 (compared with type). The sculpture of the head of these supposed species varies somewhat, but they are connected by intermediates. *A. scoticum* is represented in the British Museum collection by a male, which may not be the type but is part of the material on which the species was based. Mr. Stelfox has captured males and females together in Ireland under conditions which make the association of the sexes fairly certain.

9. *Dryinus otiartes* Walker, 1837.

The type is a male in collection 1. It is an *Anteon* which runs down to *A. vicinum* Kieffer, 1905 but differs from the male (?allotype) in having the head strongly alutaceous, but not rugose except quite laterally; mesonotum smooth and moderately shining, though weakly alutaceous throughout. The following redescription will assist in its recognition.

♂. Black, apical half of mandibles, fore tibiae and tarsi yellow-brown. Tegulae and four hind legs brown, femora paler at base, hind coxae black on basal half. Wings hyaline, veins and pterostigma brown, hardly paler proximally. L. 2 mm.

Head rather large, a little broader than thorax, not flattened, raised posterior margin a little concave, hairs rather numerous all over, inner margins of eyes a little divergent both forwards and backwards. Antennae of moderate length, a little longer than head and thorax; scape distinctly thickened towards apex, nearly straight, four times as long as broad, as long as segments 2 + 3; 2 swollen, not quite twice as long as broad; 3–9 all of about the same length, a little longer than 2, rather thick, about two and a half times as long as broad, segments with outstanding pubescence a little longer than their diameter; 10 narrower, four times as long as broad. Vertex dull, coarsely alutaceous becoming reticulately rugose on lateral quarter, a distinct keel from median ocellus to between the antennae; ocelli in a broad-based triangle, POL * : OOL = 3 : 4, posterior ocelli separated from back of head by a distance about their diameter, by a quarter of what they are from one another. Pronotum very short, hardly visible. Mesonotum rather convex, dull, finely alutaceous, becoming a little rugose on front quarter, parapsidal furrows very weak and short, depression in front of scutellum shallow, weakly crenate. Scutellum smooth and shining, nearly flat, impressed line along posterior margin distinct, crenate, post-scutellum with a small, convex, shining, central area. Mesopleuron invisible. Propodeum moderately shining, rather strongly clathrate, crenate furrow behind scutellum hardly developed, dorsal aspect hardly more than one-third as long as posterior one, posterior surface with no defined area though with a weak, bisinuate transverse keel at its dorsal end, surface with irregular transverse striae, especially below. Fore basitarsus hardly as long as next three segments together. Wings with basal vein ($M + mcu$) straight, radius with proximal and distal sections clearly separate, latter about four times as long as former.

10. *Anteon barbatum* Chitty, 1908.

I have examined two males of this species, lent by Mr. Claude Morley. One of the males is marked "type" and has a label "B.W. 25/5/02." This probably stands for Bentley Wood, near Ipswich, a locality mentioned in the original description. The other male is labelled "Cannock Chase, 27/5/06."

Chitty's description of the female appears to indicate a species very near *Anteon cursor* (Haliday) (see *note* 11). The male is perhaps a different species (at any rate, probably not the male of *A. cursor*). It falls very near *A. sisythrus* (Walker) but differs as follows:—Antennal segments 7, 8 and 9 distinctly a little longer, two and a half not twice as long as broad; four hind legs, especially mid femora, distinctly paler; mesopleuron with the upper part shining, finely rugose, the lower part quite smooth—not with upper part dull and coarsely rugose and lower part only partially smooth and shining.

---

* POL = distance separating outer edges of the posterior ocelli. OOL = distance separating inner margin of eyes from outer margin of hind ocelli.

The following is a redescription of the male.

♂. Black. Mandibles, tegulae, fore legs except black ventral streak on femora, mid legs except black ventral streak on femora, pale brown. Hind legs rather darker brown, femora darker ventrally. Wings hyaline, veins pale, pterostigma dark brown. L. 2·5 mm.

Head large, not flattened, raised posterior margin strongly concave, inner margins of eyes a little diverging forwards. Antennae long, longer than head + thorax, thick, with dense pubescence about as long as diameter of segments, scape little curved, subcylindrical, four and a half times as long as broad, nearly as long as 2 + 3; 2 pear-shaped (narrow at base) nearly twice as long as broad; 3 a little longer than 2, two and a third times as long as broad; 4–9 subequal in length, a little longer than 3, about two and a half times as long as broad; 10 four times as long as broad. Vertex dull, rather coarsely and irregularly rugose, with traces of very weak central keel and of one just inside each eye; ocelli in a very broad based triangle, POL about = OOL, posterior ocelli separated from back of head by a distance one-quarter what they are from one another. Pronotum very short, hardly visible. Mesonotum one and half times as wide as long, rather dull, rugose in front, becoming weakly alutaceous behind, parapsidal furrows extending for half its length, depression in front of scutellum shallow, hardly crenate. Scutellum smooth and shining, nearly flat, line along posterior margin weak, feebly crenate. Postscutellum with a small central, rather shining, convex area, outside this striate. Mesopleuron with furrow separating dorsal and ventral parts very shallow, dorsal part finely rugose, moderately shining, ventral part almost entirely smooth and shining. Propodeum dull, dorsally rather finely clathrate, posteriorly rather finely rugose, dorsal aspect one-third as long as posterior one, posterior surface with no clearly recognisable central area, surface defined above by an arcuate transverse keel. Fore basitarsus not quite as long as next three segments together. Wings with basal vein ($M + mcu$) almost absolutely straight, radius with proximal and distal sections well marked, the former four times as long as the latter.

11. *Anteon cursor* (Haliday).

The type of *Dryinus cursor* Haliday *in* Curtis, 1828 is in collection 4 at Dublin. There are no reasons whatever for putting it in the genus *Mystrophorus*. The latter genus is probably only a repository for short-winged species of *Prenanteon*, though *M. subapterus* (Kieffer) is distinct from all species of *Prenanteon* I have examined. The following is a redescription of *A. cursor*.

♀. Black. Mandibles yellow. Segments 1–2 of antennae, tegulae, fore tibiae and tarsi, testaceous; fore femora brown; mid legs pale brown, femora darker ventrally; hind legs dark brown, coxae black. Wings hyaline, venation colourless, pterostigma brown, with proximal pale spot and central pale streak. L. 2·25 mm.

Head of moderate size, not flattened, raised posterior margin nearly straight, hairs sparse, more numerous below antennae, inner margins of eyes a little divergent forwards. Antennae of moderate length, about as long as head + thorax, scape nearly straight, two and a half times as long as broad, about as long as 2 + 3; 2 a little thickened at apex, nearly twice as long as broad; 3 a little longer and thinner than 2, two and a quarter times as long as broad; 4–9 a little thickened, 4 a little shorter than 3, 9 one and a half times as long as broad, 10 a little shorter than 8 + 9, twice as long as broad. Vertex dull, coarsely alutaceous, with a very fine central keel from median ocellus extending across most of vertex; ocelli in a rather broad-based triangle, POL : OOL = 1 : 1, posterior ocelli separated from back of head by a distance equal to half that by which they are separated from one another. Pronotum very short, dull, alutaceous with some irregular striae at sides. Mesonotum moderately convex, dull, coarsely alutaceous, with some fine sinuous raised keels, especially in front, parapsidal furrows completely obsolete, impression in front of scutellum well-defined, regularly crenate. Scutellum smooth and shining, with two or three punctures on each side and an impressed crenate line along its posterior margin. Postscutellum rather convex, finely alutaceous. (Sculpture of pleuron not visible.) Propodeum dull, dorsally closely clathrate, crenate furrow behind postscutellum weak, only visible centrally, dorsal aspect less than half as long as posterior aspect. Whole posterior surface (not merely central area) coarsely alutaceous with sculpture quite different from that of dorsal surface, posterior surface not defined at sides but defined above by a twice-bent raised keel which is raised into small tubercles at its two lateral extremities. Fore femora moderately thickened, at thickest point no thicker than length of scape. Fore tarsi with basitarsus as long as 2 + 3 + 4 which are all very short; forceps small, when retracted fifth segment stretches along tarsi only to proximal end of fourth segment; outer arm of forceps (modified claw) moderately curved at a point rather nearer base than apex, with a slight projection bearing a hair; inner arm of forceps (fifth segment) short, straight, apex not recurved, armature obscured. Wings with basal vein (*M* + *mcu*) nearly straight; radius with distal section half as long as proximal one.

The species is separated from all those of *Anteon* I have examined by the very finely sculptured, flattened posterior surface of the propodeum.

12. *Anteon rufulocolle* Chitty, 1908.

This appears to be the species for which Kieffer uses the name *collare* Dalman, but the type of the latter requires examination. The type of Chitty's species is a female labelled " Tubney, 1/7/05, A.J.C." The following is a redescription.

♀. Black. Mandibles, antennae 1–3, pronotum, tegulae, sides of first abdominal segment, legs (except distal third of hind femora) reddish-yellow. Wings hyaline, venation pale, pterostigma dark brown, a little paler at base. L. 2·75 mm.

Head hardly at all flattened, raised posterior margin very feebly concave, inner margin of eyes distinctly converging forwards. Antennae rather short, considerably shorter than head and thorax, scape rather strongly curved, distinctly thicker at apex than base, three times as long as broad, a little shorter than 2 + 3; 2 subcylindrical, twice as long as broad; 3 rather narrow, three times as long as broad; 4–9 progressively shorter and thicker, 4 a little shorter than 3, 9 about twice as long as broad; 10 a little longer than 3. Vertex shining, with a very few fine punctures, no central keel but a weak central depression, ocelli in a large equilateral triangle, POL = OOL, posterior ocelli separated from back of head by a distance two-thirds what they are from one another. Pronotum a little longer than mesonotum, about two-thirds as long as broad posteriorly, in profile sloping regularly down to articulation of head, surface shining with some sparse shallow punctures, a crescentic posterior area entirely smooth, lateral aspect dull, finely striate. Mesonotum about twice as wide as long, shining, almost unpunctured, parapsidal furrows weak, extending over half its length, depression in front of scutellum well-defined, regularly crenate. Scutellum flat, shining, unpunctured, impressed line along posterior margin feebly crenate. Postscutellum with a broad flat central shining unsculptured area. Mesopleuron obscured. Propodeum dull, rather finely clathrate, dorsal and posterior aspects rather well separated, former half as long as latter, posterior surface with a very weakly defined, broad central area on which sculpture is rather finer. Fore femora moderately thick, at thickest diameter hardly longer than scape of antennae. Fore tarsi with basitarsus a little shorter than next three segments together, second and third segments very short, fourth hardly longer than second and third together; forceps large for this genus, when retracted fifth segment stretches along tarsi to proximal end of segment two; outer arm of forceps (modified claw) rather strongly curved, without tooth or bristles; inner arm of forceps (fifth segment) nearly straight, not incurved at apex, with a row of widely spaced lamelliform bristles each separated from the next by a finer bristle, rows getting dense at apex. Wings hyaline, basal vein almost quite straight, radius with proximal and distal sections not very distinct, former three times as long as latter.

13. *Anteon maculipenne* Kieffer, 1908.

This species is recorded from Ireland in Haliday's manuscript notes (see Stelfox, 1927, *Proc. R. Irish Acad.*, **37**(B) : 334). Its presence in our fauna requires confirmation.

14. *Anteon lyde* (Walker).

The type of *Dryinus lyde* Walker, 1837 is a male in the British Museum, series 1. It is the same species as *Anteon indivisum* Kieffer, 1905. Mr. Stelfox caught males of this species together with certain females at Powerscourt, Co. Wicklow, 27 May '32, under conditions which make it almost certain that they are the sexes of one species. The females are the same as *Dryinus brachycerus* Haliday–Walker (?of Dalman). According to the types in the British Museum, *A. rectum* Kieffer, 1905 and *A. obscuricorne* Kieffer, 1906 are also synonyms. The species should be known as *A. lyde* until Dalman's type has been examined.

15. *Anteon alorus* (Walker).

The type of *Dryinus alorus* Walker, 1837 is a male in series 4 at Dublin. Two males in the British Museum, series 2, agree better with Walker's var. γ. It is almost certainly the same as *Anteon fuscoclavatum* Kieffer, 1905. The type of the latter is now defective, the head being missing; in this condition its identity can scarcely be certainly established and I propose to maintain the above synonymy.

16. *Anteon penidas* (Walker).

The type of *Dryinus penidas* Walker, 1837 is a male in the British Museum, series 1. It is the same as *Anteon vulgare* Kieffer, 1905.

17. *Anteon nanum* (Haliday *in* Walker).

The type of *Dryinus nanus* Haliday *in* Walker, 1837 is a male in series 4 at Dublin. In Kieffer's key it runs down to *A. indivisum* Kieffer (= *lyde* Walker), but is much smaller, with a dull, alutaceous mesonotum.

The following is a redescription.

♂. Black; mandibles and fore tibiae yellow-brown; junctions of tibiae and femora and all tarsi brown. Wings hyaline, pterostigma brown. L. 1·75 mm.

Vertex dull, coarsely alutaceous, centre with a slight depression and, anteriorly, with a fine keel which becomes obsolete a little above the antennae; no lateral keels. Ocelli in an equilateral triangle, POL : OOL = 4 : 3, posterior ocelli separated from back of head by their diameter. Antennae with short pubescence, scape as long as segments 2 + 3, about two and a half times as long as broad; 4 a little longer than 3, about twice as long as broad; 5–9 all between one and a half and twice as long as broad, 10 just shorter than 8 + 9. Pronotum small, not visible in dorsal view. Mesonotum a little broader than long, dull, alutaceous (rather more shining on disc), parapsidal furrows visible as impressed lines on anterior half, impression in front of scutellum shallow, not crenate. Mesopleuron (as far as visible) dull and alutaceous. Scutellum shining, unsculptured, a little broader than long. Postscutellum moderately shining with numerous irregular, very shallow punctures. Propodeum coarsely clathrate, hardly at all shining, posterior face somewhat truncate, ill-defined by an indefinite horseshoe-shaped keel, the surface inside which is dull, and coarsely alutaceous rather than clathrate. Wings with proximal part of radius very obtusely angled with distal part and two and a half times as long as it. Abdomen small, shining black, only a little longer than the hind femur + trochanter + coxa.

18. *Dryinus jurineanus* Haliday *in* Walker.

Anteon jurineanum Latreille, 1809 is a species which has never been recognised. The specimens standing under the name in the British Museum (series 1 and 2) are a mixture of *Anteon xanthostigma* Kieffer, 1905, and *A. parvulum* Kieffer, 1905. In the Haliday collection (series 3) are specimens of the latter species.

19. *Chelogynus infectus* (Haliday *in* Walker).

The type of *Dryinus infectus* Haliday *in* Walker, 1837, p. 419, is a female in series 3 at Dublin. It is the same as *Chelogynus fusiformis* (Kieffer, 1905), according to the type of the latter in the British Museum.

The male of this species is *Dryinus inclytus* Haliday *in* Walker, 1837, p. 421, of which the type is in series 4 at Dublin. *Anteon ellimani* Chitty, 1908 is a synonym (type kindly lent by Mr. Claude Morley). Both sexes of the species are easily recognised by the very strongly defined, shining central area of the propodeum.

20. *Chelogynus fulviventris* (Haliday *in* Curtis).

The type of *Dryinus fulviventris* Haliday *in* Curtis, 1828 is a female in series 4 at Dublin. It is the same as *C. gracilicollis* (Kieffer, 1905). The species which British authors have recorded as "*Dryinus ephippiger* Dalman" is a pale form of the same species; the type of Dalman's species (1818) requires re-examination.

Kieffer (1914) ascribes a variety *similis* to Walker (1837). Walker described no such variety, the word 'similis' being merely the first word in his description of his variety γ. The variety, which may be taken to cover *ephippiger* Auctt., should be known as var. *similis* Kieffer, 1914.

21. **Chelogynus alutaceus** sp. n.

♀. Testaceous; a black spot on centre of dorsal surface of propodeum. Wings hyaline, pterostigma and veins yellow. L. 3 mm.

Head moderately large, distinctly flattened dorsally, with straight, raised posterior margin, hairs sparse, inner margins of eyes rather strongly convergent forwards. Antennae moderately long, a little shorter than head + thorax, scape nearly straight, a little swollen at underside of apex, three times as long as broad, nearly as long as 2 + 3; 2 slightly ovate, twice as long as broad; 3–5 long, narrow and parallel-sided, progressively each a little shorter, 3 about 5 times as long as broad, about three-fifths as long as scape; 6–10 a little thickened, 9 not quite twice as long as broad, 10 about two and a half times as long as broad. Vertex dull, closely alutaceous, a weak central keel proceeds forwards from median ocellus for a distance equal to twice ocellar diameter; ocelli in an equilateral triangle, POL : OOL = 4 : 5, posterior ocelli separated from back of head by a distance equal to what they are from one another. Pronotum a little longer than mesonotum, only a little broader behind than long, in profile flat and falling rather sharply to articulation of head, dull, alutaceous with some sparse, very shallow punctures, a crescentic area in front of posterior margin smooth and very shining, lateral aspect rather more coarsely sculptured. Mesonotum very little convex, moderately shining, very finely alutaceous, parapsidal furrows extending for two-thirds its length, impression in front of scutellum shallow, not crenate. Scutellum flat, smooth and shining, posteriorly with a fine impressed line which is hardly crenate. Postscutellum nearly smooth. (Sculpture of pleuron not visible.) Propodeum dull, rather coarsely crenate, transverse furrow behind postscutellum weak, dorsal aspect about two-thirds as long as posterior aspect, central area of posterior surface very poorly defined, sculpture within the area not differentiated. Fore femora strongly thickened, at thickest nearly = 1 + 2 of antennae. Fore tarsi (as far as they can be made out) with first segment about as long as second + third, fourth almost as long as 1–3 together, forceps large, when retracted fifth segment stretches along tarsi to a little beyond apex of basitarsus; outer arm of forceps (modified claw) only rather weakly curved, without tooth or bristles; inner arm of forceps (fifth segment) long, straight, only moderately recurved right at apex, details of armature obscured. Wings with basal vein ($M + mcu$) a little sinuous; radius with distal section not very sharply marked off from proximal section, about one-third as long as it.

Closely resembles the var. *similis* of *C. fulviventris*, but differs as follows :—posterior margin of head straight (not concave); antennae with scape shorter (not four times as long as broad), segment 9 longer (more than one and a half times as long as broad); POL : OOL = 4 : 5, not 3 : 4; posterior ocelli rather further from back of head; pronotum not twice as long as mesonotum; dorsal aspect of propodeum longer compared with the posterior one.

Type female in series 4 at Dublin. The specimen is apparently of Haliday's collecting, possibly in Ireland, certainly in the British Isles. Haliday had included the specimen under his *fulviventris.*

22. *Chelogynus brevicornis* (Dalman, 1818).

This species is at present very doubtfully British. It is recorded by Kieffer (1914) without exact locality, but was not recorded in Kieffer (1905). It is doubtful if he saw any further British material between these dates.

23. *Prenanteon* Kieffer.

Kieffer, 1913, *Bull. Soc. ent. France*, **1913** : 301.

The type of this genus does not appear to have been indicated. It is here fixed as *Anteon melanocera* Kieffer, 1905.

24. *Prenanteon procericornis* (Kieffer, 1905).

The type of this species is a female in the collection of the British Museum. Haliday's specimens of his and Walker's *Dryinus longicornis* (*nec* Dalman) form the material on which *Prenanteon halidayi* (Kieffer, 1906) is based. A female specimen in series 4 at Dublin may be regarded as the type and is the same as *P. procericornis*, only differing in having the hind coxae with the proximal half black.

The species which Haliday and Walker called *Dryinus ruficornis* (?not = *Gonatopus ruficornis* Dalman, 1818) is based on a female in series 4 at Dublin. It is structurally similar to *P. procericornis* but differs in colour, the antennae having segments 7–10 hardly paler than 3–6 (in *procericornis* 7–10 are pale yellow).

Dryinus rapax Haliday *in* Curtis, 1828 has been synonymised by Walker (1837) with his *D. ruficornis*. The type of *D. rapax* is apparently lost or else with Curtis' collection in Australia. The name *rapax* is better omitted from the synonymy for the present.

25. *Prenanteon crassimanus* (Haliday *in* Curtis).

The type of *Dryinus crassimanus* Haliday *in* Curtis, 1828 is probably a female standing in series 4 at Dublin under the name *flavicornis*. Walker incorrectly synonymised Haliday's species with *Gonatopus flavicornis* Dalman, 1818. The following is a redescription of the probable type.

♀. Black, mandibles, clypeus, antennae 1–2 and 6–10, tegulae and legs including coxae (except dorsal streak on hind coxae) yellowish testaceous. Wings hyaline, venation and pterostigma pale yellow. L. 2·75 mm.

Head of moderate size, not flattened, raised posterior margin distinctly though feebly concave, hairs sparse, denser anteriorly, inner margins of eyes a little divergent both forwards and backwards. Antennae long, distinctly longer than head + thorax, scape distinctly curved, thickest at mid-point, a little shorter than 3, two and a half times as long as broad; 2 a little thickened at apex, not quite twice as long as broad; 3 long, narrow, cylindrical, a little shorter than 1 + 2, about five times as long as broad, 4 a little longer, 5–9 progressively shorter but only a very little thickened, 9 two and a half times as long as broad, 10 as long as 6, about three and a half times as long as broad. Vertex shining, with sparse, fine, shallow punctures, traces of slight depression half-way between median ocellus and antennae, no keels; ocelli in a rather broad-based triangle, POL : OOL = 3 : 4, posterior ocelli separated from back of head by a rather greater distance than they are from one another. Pronotum rather long, about as long as mesonotum, about three-fifths as long as broad posteriorly, in profile almost flat, anterior part only at slightly lower level than posterior, surface anteriorly dull and fairly rugose, posteriorly shining with large shallow punctures, in lateral aspect dull, rather coarsely rugose except for broad shining ventral margin. Mesonotum nearly flat, smooth and shining, hardly punctured, parapsidal furrows strong, crenate, extending across two-thirds its length, depression in front of scutellum clearly defined and regularly crenate. Scutellum smooth and shining, convex, impressed line along posterior margin rather weakly crenate. Postscutellum with a very small shining central area, otherwise rugose. Mesopleuron with prepectus smooth with its sides rugose, furrow separating dorsal and ventral parts of episternum broad and ill-defined but quite deep, upper part of episternum dull and rugose, lower part shining smooth with a few raised rugosities. Propodeum dull, coarsely and irregularly clathrate, crenate furrow behind postscutellum broad and shallow, hardly defined, dorsal aspect about half as long as posterior one, posterior surface with no defined area. Fore femora very thick, at thickest point about as thick as 2 + 3 of antennae (thicker than 1 + 2). Fore tarsi with basitarsus a little longer than segments 2 + 3, or than 4; forceps rather small, when retracted fifth segment stretches along tarsi to proximal end of third segment; outer arm of forceps (modified claw) moderately and regularly curved, without tooth or bristles; inner arm of forceps (fifth segment) straight, strongly recurved at apex, armature not visible. Wings with basal vein (*M* + *mcu*) absolutely straight, radius with proximal and distal sections not very clearly separate, latter about one-third longer than former.

26. *Prenanteon luteipes* (Kieffer, 1905).

Walker (1837) recorded a *Dryinus frontalis* which according to Kieffer is not the same as *Gonatopus frontalis* Dalman, 1818. Kieffer misidentified Walker's species as a *Chelogynus* which he renamed *Chelogynus walkeri* Kieffer, 1914. What must be regarded as the type of *C. walkeri* is a female in series 4 at Dublin.

Mons. L. Berland was kind enough to compare another female I sent him with the type of *P. luteipes* and found them identical. *P. luteipes* (Kieffer, 1905) is, therefore, the correct name for *Chelogynus walkeri*, Kieffer, 1914.

27. *Prenanteon daos* (Walker).

The type of *Dryinus daos* Walker, 1837 is a male in series 3 at Dublin. It is the same as *Prenanteon integer* (Kieffer, 1905), and Walker's name must stand.

28. *Prenanteon misor* (Walker).

The type of *Dryinus misor* Walker, 1837 is a male in series 2 at the British Museum. The following is a redescription of the type.

♂. Black, mandibles, legs except ventral streak on mid femora, narrow apex of hind femora, and basal half of hind coxae, tegulae, yellowish testaceous. First two antennal segments somewhat brown-tinged. Wings hyaline, veins brown, pterostigma darker, proximal third whitish-tinged. L. 3 mm.

Head rather large, a little broader than thorax, not flattened, raised posterior margin distinctly convex, hairs moderately numerous all over, inner margins of eyes parallel in front, a little divergent behind. Antennae very long, nearly as long as whole insect, scape a little curved, subcylindrical, two and a half times as long as broad, just shorter than segment 3; 2 little thickened, twice as long as broad; 3 narrow and cylindrical, four times as long as broad; 4 a little longer than 3, 5–9 progressively a little shorter, but even 9 fully three times as long as broad, 10 as long as 4, segments with outstanding pubescence as long as their diameter. Vertex smooth and shining, with very sparse and shallow punctures, no keels; ocelli in a nearly equilateral triangle (base a little the broadest), OOL : POL = 2 : 3, posterior ocelli separated from back of head by a distance as great as they are from one another. Pronotum very short, posterior margin smooth and shining, in front of this with a curved transverse row of small, elongate depressions. Mesonotum smooth and shining, distinctly convex, parapsidal furrows rather strong, crenate, extending three-quarters of the way across, depression in front of scutellum deep, but not well-defined, weakly crenate. Scutellum convex, shining, with some shallow punctures, impressed line along posterior margin weak, feebly crenate. Postscutellum with a broad central area which is smooth and shining. Mesopleuron with upper and lower division of episternum separated by a deep but ill-defined furrow, upper part a little rugose, lower smooth and shining. Propodeum rather dull, irregularly and not very strongly clathrate, dorsal and posterior surfaces hardly separated, former about half as long as latter, transverse furrow behind scutellum interrupted in centre, weak and not crenate at sides, posterior surface with no defined area, with rather weaker sculpture. Fore basitarsus distinctly shorter than next three segments together. Wings with basal vein ($M + mcu$) straight, radius with proximal and distal sections not very clearly separate, former about as long as latter.

P. misor is closely allied to *P. pyrenaicus* (Kieffer, 1905) var. *parcepunctatus* Kieffer, 1914. It differs as follows :—antennae with all segments a little shorter, 1–2 testaceous, darker above (not entirely black); mandibles yellow with tip dark (not black with tip reddish); legs, except coxae, pale yellow (not mid and hind femora largely brown); scutellum more convex.

29. *Prenanteon ilus* (Walker).

The type of *Dryinus ilus* Walker, 1837 is a male in series 2 in the British Museum. The following is a redescription.

♂. Black, mandibles, legs, except apex of hind femora and base of hind coxae, tegulae, yellow-brown. Wings hyaline, veins yellow-brown, pterostigma dark brown, proximal quarter yellower. L. 2·5 mm.

Head rather large, a little broader than the thorax, not flattened, raised posterior margin distinctly concave, hairs rather numerous all over, inner margins of eyes almost parallel in front, divergent behind. Antennae long, about as long as whole insect, scape a little curved, subcylindrical, two and a half times as long as broad, a little shorter than segment 3; 2 hardly pyriform, not quite twice as long as broad; 3 about four times as long as broad, cylindrical rather thick; 4 a little longer than 3, 4–9 progressively a little shorter and thinner, but even 9 four times as long as broad and nearly as long as 3; 10 a little longer than 4; segments with outstanding pubescence nearly as long as their diameter. Vertex shining sparsely and shallowly punctured, no keels; ocelli in a nearly equilateral triangle (base a little the broadest), POL : OOL = 3 : 4, posterior ocelli separated from back of head by a distance about the same as they are from one another. Pronotum very short, moderately shining, weakly rugose, a posterior strip quite smooth and shining, a slight transverse central furrow. Mesonotum distinctly convex, smooth and shining, with some moderately close large punctures on anterior quarter, parapsidal furrows strong, crenate, extending three-quarters of the way across, depression in front of the scutellum deep, rather well-defined, weakly crenate. Scutellum smooth and shining, almost unpunctured, a little convex, impressed line along posterior margin weak, feebly crenate. Postscutellum with raised central area rugose. Mesopleuron with a rather well-defined furrow separating the upper and lower divisions of episternum, the upper a little rugose, the lower smooth and shining, the meso-meta-pleural suture preceded by a very strongly crenate furrow. Propodeum moderately shining, coarsely clathrate, dorsal and posterior aspects hardly separate, former about one-third as long as latter, transverse furrow behind postscutellum weak, hardly crenate, posterior surface with no defined area, sculpture rather weaker. Fore basitarsus about as long as next three segments together. Wings with basal vein ($M + mcu$) distinctly sinuate, radius with proximal and distal sections not clearly separate, former about three-quarters as long as latter.

P. ilus is closely allied to *P. fractinervis* (Kieffer, 1905) and *P. curvinervis* (Kieffer, 1905). From the former it differs in its more closely areolated propodeum, less closely punctured anterior part of mesonotum and shorter fourth antennal segment (more nearly of same length as third).

From *P. curvinervis* it differs in the more strongly punctured head and thorax and much more angulated radius.

BETHYLIDAE.

30. *Cephalonomia tarsalis* (Ashmead, 1893).

Gahan (1931, *J. Wash. Acad. Sci.*, **21**: 213–221) has dealt with the synonymy of this species and recorded it from this country, where it lives in granaries, etc. Richards (1933, *J. ent. Soc. S. Engl.*, **1** : 51–2) has shown that *Cephalonomia carinata* Kieffer, 1907 is another synonym.

31. *Cephalonomia waterstoni* Gahan, 1931.

Gahan (*loc. cit.*) also records the above species from this country, where it is also found in granaries.

32. *Cephalonomia formiciformis* Westwood, 1833.

All the British specimens of this genus which have been captured out of doors appear to belong to the above species, which is a parasite of Coleoptera of the genus *Cis*. The species occurs in both short- and long-winged forms and I strongly suspect that *Cephalonomia brevipennis* Kieffer, 1906 is only a brachypterous variety. It is, however, better retained as a species till more definite evidence is available. Specimens of *Cephalonomia* bred by C. J. C. Pool from specimens of *Cis* sp. taken at Wicken Fen and by Mr. D. E. Kimmins from *C. pygmaeus* taken in Epping Forest, are standing in the British Museum collection under the name *C. sulcata* Kieffer, 1906. I very much doubt the value of the character on which Kieffer bases this species. The width and depth of the furrow in front of the scutellum appears to vary; in any case the specimens mentioned above appear to be the same as *C. formiciformis*.

33. *Rhabdepyris* Kieffer.

Kieffer, 1904, *Bull. Soc. Hist. nat. Metz*, **23** : 32.

No type of this genus appears to have been indicated. *R. myrmecophila* Kieffer, 1904 is here fixed as type.

34. *Pristocera depressa* (Fab.).

Bethylus depressus Fabricius, 1805 was described from the collection of Megerle which is supposed to be preserved at the Naturhistorische Museum, Wien. Herr Dr. F. Maidl tells me, however, that the type seems no longer to exist. There is no particular reason to suppose that the modern interpretation is incorrect.

35. The British species of *Bethylus* Latreille.

There is no reason at present to suppose that there are more than two British species of this genus, *B. cephalotes* (Förster) (posterior ocelli well-separated from back of head) and *B. fuscicornis* (Jurine) (posterior ocelli close to the back of the head). *Bethylus formicarius* of British authors is probably a mixture of these two species. *Bethylus mandibularis* Kieffer, 1904 (type in the British Museum) is a male of *B. fuscicornis*. *B. syngenesiae* (Haliday, 1833) Kieffer is a short-winged variety of *B. fuscicornis*. Hellén (1920, *Medd. Soc. Fauna et Flora fenn.*, **45** : 278) separates *B. fulvicornis* Curtis from *B. fuscicornis* Jurine. The characters given by Hellén for *B. fulvicornis* are partly those of the male of *fuscicornis*; for the present, at any rate, there appear to be no good grounds for separating the British specimens of *B. fuscicornis* into two species. *B. hyalinus* Marshall, 1874, of which the type appears to be lost, is possibly distinct.

CLEPTIDAE.

36. *Cleptes semiauratus* (L.).

Recent authors, following Morice (1900, *Ent. mon. Mag.*, **36** : 129) have identified *Sphex semiaurata* Linnaeus, 1761 with a non-British *Cleptes* in which the fore coxae are broadly lamellate. In the Linnean collection at Burlington House, the type male of *Sphex semiaurata* bears Linnaeus' label and agrees with the original description. It belongs to the species now usually called *Cleptes pallipes* Lepeletier, 1805. The non-British species, *Cleptes semiauratus* of Trautmann, 1928 and other authors, requires a new name. The choice of this must be left to a specialist in the group, as various synonyms may be available.

CHRYSIDIDAE.

37. *Omalus auratus* (L.).

The type of *Sphex aurata* Linnaeus, 1758 still exists in the Linnean collection at Burlington House and agrees with the modern interpretation of the species. I am unable to determine the sex of the type.

38. *Spintharis* Klug and *Pseudochrysis* Semenow.

Spintharis was described in Ehrenberg and Klug, 1845, *Symb. Phys.* : pl. 45. It included ten new species. Of these *pumila* was made the type of a new genus, *Chrysidea*, by Bischoff (1913). Ashmead (1902) made an invalid type-fixation for *Spintharis*, since the species he chose was not originally included in the genus. The type is here fixed as *Spintharis humeralis* Klug, 1845 = *Chrysis pallidicornis* Spinola, 1838. In this sense, *Spintharis* Klug is the correct name for the group for which Trautmann (1928) uses the name *Pseudochrysis*.

Pseudochrysis Semenow, 1891, *Hor. Soc. ent. Ross.*, **25** : 444, was erected for two species *Spintharis* (*P.*) *virgo* Semenow, 1891 and *Euchroeus limbatus* Dahlbom, 1854. *S. virgo* Sem. is here fixed as type.

S. virgo is probably not congeneric with species placed by Trautmann in *Pseudochrysis*. It was placed by Bischoff (1913) in his genus *Spintharis*. Bischoff's use of the latter name appears to be incorrect since none of Klug's original species was included. It appears that the correct arrangement is as follows :—

Spintharis Klug, 1845 (= *Pseudochrysis* Trautmann *nec* Semenow).
Type. *S. pallidicornis* (Spinola).
Pseudochrysis Semenow, 1891 (= *Spintharis* Bischoff *nec* Klug).
Type. *P. virgo* Semenow.

39. *Hedychrum rutilans* Dahlbom.

Through the kindness of Dr. N. A. Kemner, I have examined the type of *Hedychrum rutilans* Dahlbom, 1854. It is a female bearing two labels (1) " Z. Mer." or " L. Mer." and (2) " *Hed. rutilans*. Megerl. secund. M.B. Dhbm. var. a." The specimen agrees with Dahlbom's description of his var. a. (*i.e.* the typical form of the species) and also with the modern interpretation of his name (*e.g.* Trautmann, 1928). Dr. Kemner also sent what is almost certainly the type of *Hedychrum intermedium* Dahlbom, 1845. This species was described in 1845 from France but in 1854 Dahlbom dropped the name *intermedium*; his var. c. of *H. rutilans* agrees with the earlier described *intermedium*.

The probable type of *intermedium* is a male bearing two labels, (1) " *Hedychr. rutilans* Dhlbm. var. c." and (2) " Hab. ?fontainebleau Collect. Barbut." This specimen agrees with the original description of *intermedium*. It is a male of one of the greenish forms of *H. rutilans*. It may be described as follows :— Green ; slight trace of copper on central lobe of mesonotum. Postscutellum and propodeum blue. Abdomen green, disc of second tergite and whole of third, copper-tinged. Legs blue. Venter of abdomen black.

In my opinion, therefore, the species should be known as *Hedychrum intermedium* Dahlbom, 1845.

40. *Chrysis cyanea* (L.).

Sphex cyanea Linnaeus, 1758 is stated to have three teeth at the apex of the abdomen. The supposed type in the Linnean collection at Burlington House although bearing Linnaeus' label, is a specimen with four apical teeth (probably *Chrysis iris* Christ). It cannot be the true type and there is no reason to alter the modern interpretation of the species.

41. *Chrysis ignita* (L.).

The type of *Sphex ignita* Linnaeus, 1758 still exists in the Linnean collection at Burlington House. It agrees with the modern interpretation of the species, but I could not determine its sex.

42. *Chrysis fulgida* Linnaeus, 1761.

The type of this species also exists at Burlington House and is a male agreeing with the modern interpretation of the species.

TIPHIIDAE.

43. *Tiphia femorata* Fabricius, 1775.

In the Fabrician collection at Kiel are 7 ♀♀ of this species, lent me by Dr. O. Schröder. One of the specimens bears Fabricius' species-label and is probably the type. All the specimens agree with the modern interpretation of the species.

SAPYGIDAE.

44. *Sapyga clavicornis* (L.).

The type of *Apis clavicornis* Linnaeus, 1758 still exists in the Linnean collection. It is a male agreeing with the original description and with the modern interpretation of the species.

MYRMOSIDAE.

45. *Myrmosa melanocephala* (Fabricius, 1793).

Mutilla melanocephala Fabricius, 1793 is preoccupied by *Mutilla melanocephala* Schrank, 1781 (now placed in *Pezomachus*). The next available name for Fabricius' species is *Myrmosa atra* Panzer, 1801, based on the male. According to information received from Mons. L. Berland, the type of Fabricius' species, described from the Bosc collection (now at Paris), is lost.

PSAMMOCHARIDAE.

46. *Priocnemis exaltatus* (Fabricius, 1775).

From Fabricius' collection at Kiel, I received a female with the label " *Sphex exaltata* " (? not in Fabricius' writing). Also two other imperfect females and one male, unlabelled. All these specimens belong to the species now known as *Priocnemis exaltatus* (Fab.), which is presumably correctly identified.

47. *Salius* Fab. and *Cryptocheilus* Panz.

Salius Fabricius, 1805, *Syst. Piez.* : 124. Type fixed by Bingham (1897, *Faun. Brit. India, Hym.*, **1** : 122) as *S. bicolor* Fabricius, 1805.

Cryptocheilus Panzer, 1806, *Krit. Rev.*, **2** : 120. Type fixed by Westwood (1840, *Introd. Mod. Class. Ins.*, **2** : *Synops.*, 82) as *Sphex annulata* Fabricius, 1798. These two types are congeneric and Fabricius' generic name is the earlier.

From Fabricius' collection at Kiel, I received three males of *S. bicolor*, one bearing the species-label. These males agree with the original description and with the modern interpretation (*e.g.* Haupt, 1927). The type of *Sphex annulata* is still preserved in the Museum national d'Histoire naturelle, at Paris and, according to information received from Mons. L. Berland, agrees with the modern interpretation of the species (*e.g.* Haupt, 1927). Unfortunately the name is preoccupied by *Sphex annulata* Lichtenstein, 1796.

According to Haupt (1927, p. 47), *Salius spectabilis* Morawitz, 1892 is only an eastern European colour variant of *S. annulata* (Fab.). This is the next valid name. For the western European form of the species, I propose the new name **annulatilis** n. These conclusions may be summarised as follows:—

Salius Fab. (= *Cryptocheilus* Panz.).
Type. *S. bicolor* Fab.
Cryptocheilus annulata (Fab.) of authors should be known as *Salius spectabilis* Morawitz var. *annulatilis* Richards.

48. *Deuteragenia variegata* (L.).

Two specimens purporting to be *Sphex variegata* Linnaeus, 1758 exist in the collection at Burlington House. One is a female with Linnaeus' label and is *D. bifasciata* (Fab.) in the sense of Haupt (1927). The other is a female marked "*variegata* ex. descr." in the handwriting of Sir J. E. Smith (one-time owner of the collection) and is *D. variegata* (L.) in the sense of Haupt. It is proposed to continue to use the name *variegata* in the sense of Haupt.

49. *Psammochares minutulus* (Dahlbom, 1842).

The name *Pompilus minutus* Dahlbom, 1829 has lately been revived by Haupt; it is preoccupied by *P. minutus* Van der Linden, 1827. *P. minutulus* Dahlbom, 1842 is the next available name.

50. *Psammochares gibbus* Auctt.

Pompilus gibbus Fabricius, 1798 is based on *Sphex gibba* Fabricius, 1775. This is preoccupied by *S. gibba* Linnaeus, 1758 (a *Sphecodes*; see note 113). The next available valid name is *Pompilus trivialis* Dahlbom, 1844, which should be used.

51. *Psammochares pectinipes* Auctt.

The type of *Sphex pectinipes* Linnaeus, 1758 still exists at Burlington House. It is a female agreeing with the original description and bearing Linnaeus' label; it is the same as *Pompilus aculeatus* Thomson, 1870 (as suggested by Haupt, 1927, p. 308).

Ps. pectinipes of British authors = *Pompilus campestris* Wesmael, 1851 should be known as *P. crassicornis* Shuckard, 1837. *Pompilus crassicornis* Schiödte, 1837 was almost certainly published later than Shuckard's species. Mr. F. J. Griffin tells me that Shuckard's "Essay on . . . Fossorial Hymenoptera" was out by 2 Jan. 1837.

52. *Psammochares fuscus* (L.).

The type of *Sphex fusca* Linnaeus, 1761 is a female still preserved in the Linnean collection at Burlington House. It agrees with the original description and with the modern interpretation of the species (= *Pompilus viaticus* of Edward Saunders, 1896).

53. *Episyron rufipes* (L.).

The type of *Sphex rufipes* Linnaeus, 1758 is a female in the Linnean collection which bears the Linnean label, agrees with the original description and with the modern interpretation of the species (Haupt, 1927).

54. *Evagetes dubius* (Van der Lind.).

Owing to the kindness of Mons. A. Ball, I have examined what is probably the type of *Aporus dubius* Van der Linden, 1827. It is a female of *Evagetes dubius* in the sense of Haupt (1927)

55. *Aporus unicolor* Spinola.

Spinola (1808, *Ins. Ligur.*, **2** : 5) described a genus *Aporus* for two species *A. unicolor* and *A. bicolor*, which are the male and female of one species.

Haupt (1927, p. 264) has created some confusion in the synonymy. He apparently examined 1 ♀ of *A. unicolor* and a number of specimens of *A. pollux* (Kohl, 1888). Under the name *unicolor* he synonymises two distinct genera and three distinct species. (1) *A. unicolor* Spinola. This is the species which he actually describes and the only species found in Great Britain. Haupt incorrectly synonymises *unicolor* of E. Saunders with *pollux*. (2) *Planiceps latreillei* of Berland, and (3) *P. fulviventris* of Berland with its var. *helveticus*. Mons. Berland (1925, *Faune de France, Hym. Vesp.*, **1** : 277) has described these last two species in a perfectly recognisable way, and it is evident that Haupt cannot have seen specimens. The head is far more flattened, the fore femora more dilated and the pronotum much longer than in *A. unicolor*. Berland has placed them in a separate genus, *Planiceps*. I think this course is undoubtedly correct, but the nomenclature of these forms is involved, and I would not commit myself without further study as to the proper names of *Planiceps* and its two species.

I have specimens of the females of both of them from the South of France. In *P. latreillei*, the clypeus has the anterior margin evenly curved and the clypeus is six to seven times as broad as high. In *P. fulviventris helveticus*, the margin of the clypeus is also evenly curved and the clypeus is nearly four times as broad as high. In *Aporus unicolor* ♀, the clypeus is broadly emarginate and is about four times as broad as high. Haupt's figure 131 of the head of *Aporus* (sex not stated) shows a clypeus with evenly curved margin, three and a half times as broad as high. If this figure is taken from *A. pollux* Kohl ♀, that species must be very distinct from *A. unicolor*. I have taken the opportunity to gather together records of the occurrence of *A. unicolor* in England, based on an examination of the Hope, the British Museum and my own collections and records in Saunders (1896). E. Suffolk (Saunders), S. Essex (Saunders), E. Kent (Hope coll.), E. Sussex (Frisby, 1906), S. Hants (Hope coll.), I. of Wight (Hope coll.), Surrey (Hope coll.), Oxford (Goring, O. W. R.), Dorset (Hope coll.), W. Cornwall (Treen, O. W. R. coll.).

VESPIDAE.

56. *Eumenes coarctata* (L.).

The type of *Vespa coarctata* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It belongs to the form in which the second abdominal tergite is almost impunctate.

57. *Eumenes argillacea* (L.).

The type of *Sphex argillacea* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It belongs to an exotic species unknown to me.

58. *Odynerus spinipes* (L.).

The type of *Vespa spinipes* Linnaeus, 1758 is a male in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

59. *Ancistrocerus parietum* (L.).

The type of *Vespa parietum* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

60. *Ancistrocerus pictus* (Curtis).

There has been some confusion in the continental literature as to the nomenclature of this species. *Odynerus pictus* Curtis, 1826 is the British race of *O. oviventris* Wesmael, 1838. The two are not specifically distinct but differ with considerable regularity in the colour of the legs. The British form occurs very rarely as an aberration of race *oviventris* on the Continent.

61. *Ancistrocerus trimarginatus* (Zetterstedt).

Owing to the kindness of Dr. N. A. Kemner, I have been able to examine the type of *Odynerus trimarginatus* Zetterstedt, 1838. It is a female of *Vespa trifasciatus* Fabricius, 1787, *nec* O. F. Müller, 1776. Fabricius' well-known name being preoccupied, Zetterstedt's name must be used.

62. *Ancistrocerus albotricinctus* (Zett.).

Dr. N. A. Kemner also lent me the type of *Odynerus albotricinctus* Zetterstedt, 1838. It is a male of a form of *A. trimarginatus* Auctt. (*nec* Zett.). This species is found in several varieties; with white or yellow abdominal bands; with three or five transverse bands on the tergites; with the tibiae reddish, yellowish or whitish. All these forms are identical in the structure of the thorax and of the second abdominal sternite, by which alone the species can be recognised. In our fauna, white-banded forms occur in Ireland and Scotland. The name *albotricinctus* must replace *trimarginatus*, which has hitherto been wrongly applied.

63. The type of the genus *Symmorphus* Wesmael, 1836 (*Bull. Acad. Sci. Belg.*, **3** : 45).

Ashmead's designation (1902, *Canad. Ent.*, **34** : 209) is invalid, because *Vespa sinuata* Fabricius was not originally included. The type is here fixed as *Odynerus elegans* Wesmael, 1833.

64. *Symmorphus sinuatus* (F.).

Vespa sinuata Fabricius, 1793 is preoccupied by *Vespa sinuata* Fourcroy 1787. I propose **Symmorphus sinuatissimus** nom. n.

65. *Symmorphus bifasciatus* (L.).

The type of *Vespa bifasciata* Linnaeus, 1761 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

66. *Symmorphus murarius* (L.).

The type of *Vespa muraria* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

67. *Vespa* species.

The types of *Vespa crabro*, *V. vulgaris* and *V. rufa* Linnaeus, 1758 are ♀, ♀ and ☿ respectively in the Linnean collection at Burlington House. They all agree with the usual modern interpretation of the species.

SPHECIDAE.

68. *Tachysphex nitidus* (Spinola).

The species which British entomologists have always known as *Tachysphex unicolor* (Panzer, 1806–1809) is now usually synonymised by Continental authors with *T. nitidus* (Spinola, 1805). The types of these species really require re-examination.

69. *Tachysphex pectinipes* Auctt. (*nec* Linnaeus).

Linnaeus' *Sphex pectinipes* not being a Larrine (see note 51) another name is required for this species. The correct one is *Larra pompiliformis* Panzer, 1805 *nec* 1808. Baron K. von Rosen lent me Panzer's type female, now in Sturm's collection at Munich. This change has further repercussions in the nomenclature of the LARRINAE, and I take this opportunity of dealing with the synonymy of several non-British genera.

70. *Larra* Fabricius, 1793 (*Ent. Syst.*, **2** : 220).

Type (fixed by Latreille, 1810, *Consid. génér.* : 438) = *Larra ichneumoniformis* Fabricius, 1793 = *Sphex anathema* Rossi, 1790.

Synonyms. *Larrada* Smith, 1856 (*Cat. Hym. B.M. Sphegidae, etc.*, **4** : 273). Type (fixed by Girard, 1879, *Traité d'Ent.* **2** : 953) = *Sphex anathema* Rossi, 1790. *Cratolarra* Cameron, 1900 (*Ann. Mag. nat. Hist.*, (7) **5** : 34). Type (monobasic) = *Cratolarra femorata* Cameron, 1900.

Owing to the kindness of Prof. G. D. H. Carpenter, I have examined the type of Cameron's species in the Rothney collection at Oxford. It is a female of a true *Larra* with the first two antennal segments very shiny (as in *L. anathema*) and posteriorly truncate pronotum. It is closely allied to *L. erratica* Bingham, 1897 and is the same as the species identified (?correctly) in the British Museum collection as *L. maura* (Fab.). The pygidium is closely punctate-striate, but not hairy.

71. *Tachytes* Panzer, 1806 (*Krit. Rev.*, **2** : 129).

Type (monobasic) = *Pompilus tricolor* Panzer, 1801 (*nec* Fabricius, 1793) = *Tachytes europaea* Kohl, 1883.

Pompilus tricolor Panzer (1801, *Faun. Ins. Germ.*, **84** : 19) is not the same as *Pompilus tricolor* Fabricius, 1798, according to Kohl, who therefore renamed the former.

Pompilus tricolor Fabricius, 1798 = *Sphex tricolor*, 1793 is also referred to *Tachytes* by Kohl, but it will require another name, as it is preoccupied by *Sphex tricolor* Schrank, 1781.

Synonyms. *Lyrops* Latreille, 1809 (*Gen. Crust. Ins.*, **4** : 71). Type (fixed by Latreille, 1810, *Consid. génér.* : 438) = *Larra tricolor* Fabricius, 1805 = *Sphex tricolor* Fabricius, 1793. *Tachyptera* Dahlbom, 1844 (*Hym. Europ.*, **1** : 133) *nec* Berge, 1842, includes two species, both now placed in *Tachytes*.

72. *Liris* Fabricius, 1805 (*Syst. Piez.* : 227).

Type (fixed by Bingham, 1897, *Faun. Brit. India Hym.*, **1** : 205) = *Liris aurata* Fabricius, 1805 = *Sphex aurata* Fabricius, 1787 *nec* Linnaeus, 1758. Fabricius' species should probably be known as *L. opulenta* (Lepeletier, 1845).

73. *Tachysphex* Kohl, 1883 (*Deuts. ent. Z.*, **27** : 166).

Type (fixed by Bingham, 1897, *Faun. Brit. India Hym.*, **1** : 192) = *Tachysphex filicornis* Kohl, 1883.

74. *Leptolarra* Cameron, 1900 (*Ann. Mag. nat. Hist.*, (7) **5** : 29) = *Notogonia* Auctt.

Type here fixed as *L. reticulata* Cameron, 1900.

The type of *L. reticulata* is a female (with the abdomen missing) in the collection of the British Museum. It belongs to a race of *Notogonia nigricans* (Walker, 1871). Saussure (1892) described a *Notogonia reticulata* from Madagascar, so Cameron's species needs a new name. I here propose **Leptolarra nigricans** (Walk.) **reticuloides** subsp. n.

Synonyms. 1. *Notogonia* Costa, 1867 *nec* Perty, 1850. Type (monobasic) = *N. nigra* Costa, 1867 = *Tachytes niger* Van der Linden, 1829.

2. *Notogonidea* Rohwer, 1911, with the same type.

The type-species of these two genera is commonly referred to as *Notogonia pompiliformis* (Panz.), i.e. *Larra pompiliformis* Panzer, 1808 (*Faun. Ins. Germ.*, **106** : 17). But Panzer himself had already used this name for another species (see note 69). *Notogonia pompiliformis* of authors should in future be known as *Leptolarra* (*Spanolarra*) *agilis* (Smith) = *Larrada agilis* Smith, 1856. *Tachytes nigra* Van der Linden, 1829, on which Costa based *Notogonia*, is not a species described by Van der Linden but is based on *Sphex nigra* Gmelin, 1790 = *S. nigra* Fabricius, 1775. The latter is a *Psammochares* = *Sphex nigerrima* Scopoli, 1763.

3. *Spanolarra* Cameron, 1900 (*Ann. Mag. nat. Hist.*, (7) **5** : 32). Type (monobasic) = *S. rufitarsis* Cameron, 1900.

Owing to the kindness of Prof. G. D. H. Carpenter, I have examined the type of *S. rufitarsis* from the Rothney coll. at Oxford. It is a female of a true *Leptolarra* (*Notogonia* Auctt.) belonging to the group with a bare, shiny pygidium. The name *Spanolarra* may be used for this group as a subgenus (= *Cratolarra* F. X. Williams, 1928 *nec* Cameron, 1900), including also *L. agilis* (Smith) (= *pompiliformis* Auctt.) and *L. opalipennis* (Kohl.).

4. *Caenolarra* Cameron, 1900 (*Ann. Mag. nat. Hist.*, (7) **5** : 28). Type (monobasic) = *C. appendiculata* Cameron, 1900.

By the kindness of Prof. G. D. H. Carpenter, I have examined the type in the Rothney collection at Oxford. It is a male of a small black species of typical *Leptolarra*.

75. *Lyroda* Say, 1837 (*Boston J. nat. Hist.*, **1** : 372).

Type (fixed by Bingham, 1897, *Faun. Brit. India Hym.*, **1** : 208) = *Lyroda subita* Say, 1837.

Synonyms. 1. *Morphota* Smith, 1856 (*Cat. Hym. B.M. Sphegidae, etc.*, **4** : 293). Type here fixed as *M. formosa* Smith, 1856. This species is absolutely congeneric with *L. subita*.

2. *Odontolarra* Cameron, 1900 (*Ann. Mag. nat. Hist.*, (7) **5** : 35). Type (monobasic) = *O. rufiventris* Cameron, 1900.

By the kindness of Prof. G. D. H. Carpenter, I have examined the type of *O. rufiventris* in the Rothney collection at Oxford. It is a female of a true *Lyroda* (as already noted by Turner, 1914). It is very close to *Morphota formosa* Smith, but differs in the red third abdominal tergite, finer sculpture of the propodeum and darker wings.

76. *Podalonia* Spinola.

The two British species of *Ammophila* with a short petiole are probably best placed in a separate genus. Fernald has shown that *Psammophila* Dahlbom, 1842 *nec* Brown, 1827 is preoccupied. The next available name is *Podalonia* Spinola, 1853.

The type of *Sphex viatica* Linnaeus, 1758 is preserved in his collection at Burlington House. It is a female of *Podalonia hirsuta* (Scopoli, 1763). Linnaeus himself says the insect preys on caterpillars, so there is no excuse for using " *viatica* " as the specific name of a Psammocharid.

The other British species was called " *Ammophila lutaria* " by Saunders. *Sphex lutaria* Fabricius, 1787 has never satisfactorily been identified; the type is lost and even the genus of the species is uncertain. The correct name for this species is *Podalonia affinis* (Kirby, 1798).

77. The type of *Stigmus pendulus* Panzer, 1801–2.

In Sturm's collection at Munich is a male and a female *Stigmus*, one of which is almost certainly the type of *S. pendulus* Pz. The female agrees with the modern interpretation of the species but the male belongs to *S. solskyi* Morawitz. The female may be regarded as the type of *pendulus*. Baron K. von Rosen sent both specimens for examination.

78. *Cemonus rugifer* Dahlbom, 1844.

Blüthgen (1931, *Konowia*, **10** : 121–9) has published a critical review of the species of the genus *Cemonus* (= *Dineurus* Westw.). In his opinion, *C. rugifer* (of which he examined the type) is a variable species, of which *C. unicolor* (Panzer, 1797) *nec* (Fabricius, 1787) is a synonym; *C. wesmaeli* Morawitz, 1864 and *C. scoticus* (Perkins, 1929) are only varieties, as various intermediates occur.

79. The British species of *Passaloecus*.

The synonymy of the species of this genus has been somewhat harshly dealt with by continental authorities but British usage is correct. There is no reason to doubt that *P. gracilis* (Curtis, 1834) is an earlier name for *P. tenuis* Morawitz, 1864.

Of *P. insignis* (Van der Linden, 1829), I have examined a female (lent by Mons. A. Ball) which formed part of the material on which the species was based. Of *P. turionum* Dahlbom, 1844, I have examined two males (lent by Dr. N. A. Kemner), one of which is probably the type. It is almost identical with *P. insignis* and is probably a synonym of it, but, in my opinion, the European species of the genus require revision. In any case, the British form is *P. insignis*. *P. brevicornis* Morawitz, 1864 is another synonym.

80. Synonymy of two species of *Mimesa.*

By the kindness of Dr. O. Schröder, I have been able to examine a labelled male of *Trypoxylon equestre*, Fabricius, 1805 from the Fabrician collection at Kiel. It will be noted that the original description " Pedes nigri, tarsis rufis . . ." and " segmento secundo toto rufo . . ." agrees better with *Mimesa bicolor* (Jurine, 1807) than with *M. equestris* Auctt. Actually the type is a specimen of *M. bicolor* and Fabricius' name must be adopted. *M. equestris* Auctt. *nec* Fab. should be known as *Mimesa rufa* (Panzer, 1805).

81. *Psenulus pallipes* Auctt.

Harttig (1931, *Stettin. ent. Ztg.*, **92**: 203–10) in his revision of the genus *Psenulus*, showed that *Sphex pallipes* Panzer, 1798 cannot be recognised. He proposed the name *P. rubicola* for the species that has hitherto gone under that name.

By the kindness of Dr. O. Schröder, I have examined a male, labelled by Fabricius, of *Trypoxylon atratum* Fabricius, 1805 from the collection at Kiel. The specimen agrees with the original description, and is the same as *P. rubicola* Harttig, which should be known as *P. atratus* (Fab.).

82. A note on the genus *Oxybelus.*

The type of *Vespa uniglumis* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It belongs to the species universally known as *O. uniglumis* (L.). *O. nigripes* (Oliv.) has long stood in the British list. There is no reason to think that it occurs in this country. The specimen on which the record was based has no definite data (see Shuckard, 1837, *Brit. Foss. Hym.*, 110), though it still exists in the collection of British Hymenoptera at the British Museum. As is well known, there are many other specimens of non-British insects in this collection.

83. *Crabro cribrarius* (L.).

The type of *Vespa cribraria* Linnaeus, 1758 is a male in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

84. *Coelocrabro*, Thomson.

Thomson, 1874, *Hym. Scand.*, **3** : 262.

This genus does not seem to have had a type fixed. *Crabro pubescens* Shuckard, 1837 is here designated type.

85. *Coelocrabro leucostomus* (L.).

The type of *Sphex leucostoma* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It bears Linnaeus' label and agrees with the original description but is a specimen of *Crabro carbonarius* Dahlbom, 1838. Linnaeus' name must be transferred to this species.

C. leucostomus Auctt. requires a new name. *C. bidens* Haliday, 1833 is the next available one, but this is preoccupied by *C. bidens* Schrank, 1802. Kohl (1915, p. 225) suggests that *Crossocerus niger* and *Crossocerus rufipes* Lepeletier and Brullé, 1835 may both be synonyms, but this is quite uncertain without examination of the types. Until such examination can be made, I propose the new name, **Coelocrabro leucostomoides** nom. n.

86. *Crossocerus palmipes* (L.).

The type of *Sphex palmipes* Linnaeus, 1767 is a male in the Linnean collection at Burlington House. It bears a label " ex. descr." in the handwriting of Smith. It is a specimen of *Crossocerus palmarius* (Schreber, 1784) and the original description supports this synonymy, whereas the male of *Crossocerus palmipes* Auctt. disagrees with the original description. *C. palmipes* (L.) has a yellow spot on postscutellum absent in *palmipes* Auctt.; it has the four front tibiae yellow; in *palmipes* Auctt. the mid ones are mainly black. The front legs of *palmipes* Auctt. are hardly "*palmatus*." In *palmipes* (L.) the expanded tibia has some black marks at its apex which Linnaeus probably refers to in his phrase "*quasi digitis*."

Linnaeus' name must be used for *C. palmarius* Auctt. and *C. palmipes* Auctt. should be known as *Crossocerus tarsatus* (Shuckard, 1837).

87. *Crossocerus varus* Lepeletier and Brullé, 1835.

The above spelling of the specific name is that employed in the original description. *Crabro* " *varius* " of authors is an unnecessary emendation. It should be noted that there is a species *Crabro varus* Panzer, 1799. If *Crossocerus* is sunk as a subgenus of *Crabro*, Lepeletier and Brullé's name is preoccupied, and their species would have to be known as *C. pusillus* Lepeletier and Brullé, 1835. In my opinion, *Crossocerus* is a valid genus and this point does not arise.

88. The two British species of *Blepharipus*, Lepeletier and Brullé, 1835.

The type of *Crabro signatus*, 1798 still exists in the collection of the Zoolog. Museum der Universität, Berlin. According to information received from Dr. H. Bischoff, the type agrees with the modern interpretation of the species. Unfortunately the name is preoccupied by *Crabro signatus* Olivier, 1791. The species should be known as *Blepharipus confusus* (Schulz, 1906).

The type of *Crabro dimidiatus* Fabricius, 1781 is a male in the Fabrician collection at Kiel. Owing to the kindness of Dr. O. Schröder, I have been able to examine it and find it is the same as *Crabro serripes* Panzer, 1797. The type of the latter species still exists at the Zoolog. Museum der Universität, Berlin, and information received from Dr. H. Bischoff confirms the usual modern identification of Panzer's species. The species should be known as *B. dimidiatus* (F.).

89. *Thyreus* Lepeletier and Brullé, 1835.

Lepeletier and Brullé, 1835, *Ann. Soc. ent. France*, **3** : 761.

Type (monobasic) = *Crabro vexillatus* Panzer, = *Apis clypeata* Schreber, 1759.

This name is preoccupied by *Thyreus* Panzer, 1806 and *Thyreus* Swainson, 1821. To replace *Thyreus* Lep. & Br., I propose **Clypeocrabro** nom. n., type *Apis clypeata* Schreber, 1759 = *Thyreus clypeatus* Auctt.

90. *Acanthocrabro vagabundus* (Panzer).

The type female of *Crabro vagabundus* Pz., 1798 is in Sturm's collection at Munich and was lent by Baron K. von Rosen. It agrees with the usual modern interpretation of the species.

91. The type of *Clytochrysus* Morawitz, 1864.

Morawitz, 1864, *Bull. Acad. Sci. St. Pétersbourg*, **7** : 453.

The date of this genus is often given as 1866. The name was published with included species in 1864, though not diagnosed till 1866. Ashmead (1899) fixed the type as *Crabro sexcinctus* Panzer but, in 1864, that species was not included in the genus. The type is here fixed as *Crabro chrysostomus* Lepeletier & Brullé, 1835.

92. *Clytochrysus zonatus* (Panzer).

The type male of *Crabro zonatus* Pz., 1797 is in Sturm's collection at Munich. It was lent by Baron K. von Rosen and agrees with the usual modern interpretation of the species.

93. *Metacrabro fossorius* (L.).

The type of *Sphex fossoria* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the modern interpretation of the species.

94. *Solenius vagus* Auctt.

The type of *Sphex vaga* Linnaeus is a *Mellinus*, see note 100. The Crabronid for which the name has been used should be known as *Solenius continuus* (Fabricius, 1805).

95. The genera *Rhopalum* and *Physoscelus* Auctt.

Rhopalum Stephens, 1829.
Stephens, 1829, *Nomencl. Brit. Ins.* : 34.
Curtis, 1837, *Brit. Ent.* : pl. 656.

Type (fixed by Curtis) = *Crabro rufiventris* Panzer, 1799 = *Sphex clavipes* Linnaeus, 1758.

Synonym. *Physoscelus* Lepeletier & Brullé, 1835. Type (fixed by Westwood, 1840) = *C. rufiventris* Panzer, 1799.

Corynopus Lepeletier & Brullé, 1835.
Lepeletier & Brullé, 1835, *Ann. Soc. ent. France,* **3** : 802.

Type (monobasic) = *Crabro tibialis* Fabricius, 1798 *nec* Olivier, 1791 = *Sphex coarctata* Scopoli, 1763.

The other British species of *Corynopus* is *C. nigrinum* (Kiesenwetter, 1849). Kiesenwetter described the species as *Rhopalum nigrinum.* Morawitz united *Rhopalum* to *Crabro* and therefore sunk *R. nigrinum* to *Crabro nigrinus* (Herrich-Schäffer, 1841); he proposed the name *Crabro kiesenwetteri* Morawitz, 1866 for Kiesenwetter's species. As, however, *Corynopus* (= *Rhopalum* Auctt.) is a good genus, Kiesenwetter's name must stand.

96. *Gorytes mystaceus* (L.).

The type of *Sphex mystacea* Linnaeus, 1761 is a female in the Linnean collection at Burlington House. It agrees with the modern interpretation of the species.

97. *Gorytes campestris* Auctt.

The type of *Vespa campestris* Linnaeus, 1761 is a female in the Linnean collection at Burlington House. It bears Linnaeus' label and agrees with the original description, but it is a specimen of *Gorytes mystaceus* (L.).

Gorytes campestris of authors should be known as *G. fargeii* Shuckard 1837.

98. *Hoplisus quadrifasciatus* (Fab.).

The type of *Mellinus quadrifasciatus* Fabricius, 1805 is preserved in the Fabrician collection at Kiel. Owing to the kindness of Dr. O. Schröder, I have been able to examine it and find that it is a male agreeing with the modern interpretation of the species.

99. *Bembix rostrata* (L.).

The supposed type of *Apis rostrata* Linnaeus, 1758 is a male of *B. rostrata* Auctt. But, as remarked in note 1 (footnote), Linnaeus' actual specimen no longer exists. However, there is no reason to doubt the usual interpretation of the species.

100. *Mellinus arvensis* (L.).

The type of *Vespa arvensis* Linnaeus, 1758 (p. 573) is a female in the Linnean collection at Burlington House. It agrees with the modern interpretation of the species.

The type of *Sphex vaga* Linnaeus, 1758 (p. 571) is a male in the same collection. It bears Linnaeus' label and agrees with the original description, but it is a male of *M. arvensis* not of a Crabronid (see note 93).

In view of the extensive literature attached to the name "*arvensis*" and to "*vaga*" (wrongly identified), it is not proposed to employ the latter name, although it has priority by two pages.

101. *Cerceris emarginata* (Panzer).

The type of *Philanthus emarginatus* Pz., 1799 is a female in Sturm's collection at Munich, and was lent by Baron K. von Rosen. It agrees with the usual modern interpretation of the species. The type of *Philanthus sabulosus* Pz., 1799 is a male of the same species. The name *sabulosus* occurs on pl. 13 of *Faun. Insect. Germ.*, **63** and thus has page priority over *emarginatus* (pl. 19). The species should be known as *Cerceris sabulosa* (Panzer) 1799.

102. *Cerceris quadricincta* Auctt.

This name is founded on *Sphex quadricincta* Villers, 1789; this is only a misidentification of *Crabro quadricinctus* (Fabricius, 1787 and is, in any case, preoccupied by *Sphex quadricincta* Scopoli, 1786. The next available name, accepted as a synonym by Schletterer in his monograph (1887), is *Cerceris fasciata*, Spinola, 1806.

103. *Cerceris arenaria* (L.).

The type of *Sphex arenaria* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

104. *Cerceris labiata* (Fab.).

Crabro labiatus Fabricius, 1793 is preoccupied by *Crabro labiatus* Olivier, 1791. The next available name, accepted as synonymous by Schletterer in his monograph (1887), is *Crabro cunicularius* Schrank, 1802. The species should be known as *Cerceris cunicularia* (Schrank).

APIDAE.

105. *Colletes succincta* (L.).

The type of *Apis succincta* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern identification of the species. Kirby (1802, **2** : 33) came to the same conclusion and it is probably safe to disregard Linnaeus' somewhat unfortunate diagnosis of the mouth parts.

I have had access to a letter written by William Kirby to G. A. McLeay (June 10th, 1801) in which he mentions receiving from Latreille a specimen of "*Hylaeus glutinosus*" and finding it to be the same as *Apis succincta*. *Hylaeus glutinosus* Latreille is probably the same as *Apis glutinans* Cuvier, 1798, a name which is sometimes used for this species.

It may be noted that the gender of *Colletes* Latreille, 1802 is feminine, see Latreille (1805, *Hist. nat. Crust. Ins.*, **13** : 359).

106. *Colletes similis* Schenck.

Blüthgen (1930, *Mitt. schweiz. ent. Ges.*, **14** : 194) has recently shown that *Colletes similis* Schenck, 1843 is an earlier name for *Colletes picistigma* Thomson, 1872.

107. *Colletes cunicularia* (L.).

The type of *Apis cunicularia* Linnaeus, 1758 is a female in the Linnaean collection at Burlington House. It agrees with the usual modern interpretation of the species.

108. *Prosopis annulata* (L.).

The cotypes of *Apis annulata* Linnaeus, 1758 are a male and female on one pin in the Linnean collection at Burlington House. They belong to the species *Hylaeus borealis* Nylander, 1852.

109. *Prosopis signata* (Panzer).

Recently authors have used the name *P. pratensis* (Fourcroy or Geoffroy) for this species. *Vespa pratensis* Fourcroy, 1785 is preoccupied by *Vespa pratensis* Miller, 1759. The next available name, the synonymy of which is certain, is *Sphex signata* Panzer, 1798.

110. *Halictus* Latreille.

Latrielle, 1804, *N. Dict. Hist. nat.*, **24** : 182.

There appears to be no valid designation of the type of this genus. Most authors have referred to later redescriptions of the genus, in which different species were included. In the 1804 description only *Andrena rufipes* Fabricius, *Hylaeus quadricinctus* Fabricius and *H. flavipes* Fabricius were included. *H. quadricinctus* Fabricius = *Apis quadricincta* Fabricius, 1776 is here chosen as type.

111. *Halictus tumulorum* (L.).

The co-types of *Apis tumulorum* Linnaeus, 1758 are two males gummed on a card in the Linnean collection at Burlington House. They agree with the most recent interpretations of the species.

112. *Sphecodes albilabris* (Fab.).

Owing to the kindness of Dr. O. Schröder, I received from the Fabrician collection at Kiel, a specimen of *Nomada albilabris* Fabricius, 1793. The specimen is a headless male but certainly belongs to *Sphecodes fuscipennis* (Klug *in* Germar, 1822), a variety with a black mark at base of the first abdominal tergite. The specimen bears Fabricius' label and agrees with the original description. I think it is certainly the type of this hitherto unrecognised species.

113. *Sphecodes gibbus* (L.).

The type of *Sphex gibba* Linnaeus, 1758 is a female, without abdomen or hind legs, in the Linnean collection at Burlington House. As far as can be ascertained in its present state, it agrees with the usual modern interpretation of the species.

Von Dalla Torre and other authors have treated *Nomada gibba* Fabricius, 1793 not as a new description but merely as a redescription of *Sphex gibba* Linnaeus, 1758. The point is of some importance as *N. gibba* Fabricius, 1805 is the type of the genus *Sphecodes*. Actually, in the original description of

Nomada gibba (1793, *Ent. Syst.*, 2 : 348), there is a short description, a reference to the *Nomada succincta* of Scopoli, and no mention at all of the Linnean species. Dr. O. Schröder kindly sent a number of specimens of *Sphecodes* (also two *Ammobates carinatus* Mor.) standing under the name " *gibba* " in Fabricius' collection at Kiel. None of the specimens bore Fabricius' label and three or four species (including one probable but damaged *Sphecodes gibbus*) were confused. I see no reason for the present why *Nomada gibba* Fabricius, 1793 should not be regarded as synonymous with *Sphecodes gibbus* (Linnaeus, 1758), which is, therefore, the type of the genus.

114. *Sphecodes ephippius* (L.).

The type of *Sphex ephippia* Linnaeus, 1767 is a male in the Linnean collection at Burlington House. It belongs, I think almost certainly, to *Sphecodes divisus* (Kirby, 1802) = *S. similis* Wesmael, 1835. Examination of the genitalia would render the identification absolutely certain, but I feel sure enough of the synonymy to adopt Linnaeus' name.

115. *Sphecodes ferruginatus* von Hagens, 1882.

Some recent authors have synonymised this name with *Apis rufescens* Fourcroy, 1785. This is a valid name and was probably founded on a *Sphecodes*, but the correctness of the specific synonymy is very doubtful until the type (if still in existence) is examined.

116. *Andrena nitida* (Fourcroy).

Apis nitida Fourcroy, 1785 is preoccupied by *Apis nitida* Müller, 1776. The next available name, of which the synonymy is fairly certain, is *Andrena pubescens* Olivier, 1789. This is not the same as *Melitta pubescens* Kirby, 1802. [= *M. fuscipes* Kirby, 1802.]

117. *Andrena cineraria* (L.).

The type of *Apis cineraria* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

118. *Andrena helvola* (L.).

The type of *Apis helvola* Linnaeus, 1758 is a rather worn female in the Linnean collection at Burlington House. As far as can be ascertained in its present state, it agrees with the usual modern interpretation of the species.

119. *Andrena fulva* (Schrank).

Apis fulva Schrank, 1781 is preoccupied by *Apis fulva* Allioni, 1766. The next available name appears to be *Apis armata* Gmelin, 1790 (founded on the male). This antedates *A. armata* Fabricius, 1793 (an unrecognised species of *Centris*). The species should be known as *A. armata* (Gmelin).

120. *Andrena sericea* (Christ).

Apis sericea Christ, 1791 is preoccupied by *Apis sericea* Forster, 1771. The next available name for this species is *Mellita barbilabris* Kirby, 1802 (p. 151, ♂). As the name requires changing in any case, it is as well to adopt *barbilabris* which has page-priority over *Mellitta albicrus* Kirby 1802, (p. 156, ♀) which was formerly in use.

121. *Andrena cingulata* (Fab.).

The type of *Nomada cingulata* Fabricius, 1775 is probably lost. A specimen labelled " *cingulata* " in the Fabrician collection at Kiel is probably not the type which was stated in the original description to be of the size of "*Nomada*" *annulata* (i.e. *Prosopis*) and to have pale wings. The labelled specimen is a large *Sphecodes* with no head or abdomen and rather dark wings. There is no reason to change the name of this species.

122. *Melitta* Kirby.

Kirby, 1802, *Mon. Apum Angliae*, **1** : 130–134; **2** : 4.

Apparently no type of this genus has ever been designated. It is here fixed as *Melitta tricincta* Kirby, 1802.

123. *Dufourea* Lepeletier.

Lepeletier, 1841, *Hist. nat. Ins. Hym.*, **2** : 227.

Apparently no type of this genus has even been designated. It is here fixed as *Dufourea minuta* Lepeletier, 1841.

124. *Dasypoda hirtipes* (Fab.).

The type of *Andrena hirtipes* Fabricius, 1793 has been kindly sent by Dr. O. Schröder from the Fabrician collection at Kiel. It is a female, bearing Fabricius' label and agreeing with the original description, of *Andrena plumipes* Panzer, 1797. Associated with the type were the following other specimens :—

(*a*) Specimen labelled "*hirta*" and agreeing with the original description of *Apis hirta* Fabricius, 1793 *nec* Schrank, 1781. This is a male of *D. hirtipes*.

(*b*) A headless male labelled "*hirtipes*." This does not agree with the original description of that species. It is a male of *Dasypoda thomsoni* Schletterer.

(*c*) Five unlabelled specimens, including 2 ♂♂ *D. hirtipes*, 1 ♀ (no abdomen) probably *D. hirtipes*, 1 ♂ *D. thomsoni* and 1 ♀ of *D. argentata* (Panzer).

125. *Megilla*, Fabricius, 1805.

Fabricius, [1805], *Syst. Piez.* : 328.

Apparently no type has ever been designated for this genus. It is a very composite group originally including sixty-three species. Of these *Apis acervorum* Linnaeus, 1758 is here chosen as type. *Megilla* is, therefore, a synonym of *Anthophora* Latreille, 1803, which has the same type.

126. *Anthophora retusa* (L.).

The type of *Apis retusa* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species, belonging to the form with entirely black abdominal pubescence.

127. *Anthophora quadrimaculata* (Panzer).

Continental authors have recently adopted *A. vulpina* (Panzer) as the name for this species. But *Apis vulpina* Panzer, 1798 is preoccupied by *Apis vulpina* Christ, 1791. The correct name, as also that employed by E. Saunders (1896), is *Anthophora quadrimaculata* (Panzer, 1798).

128. *Eucera longicornis* (L.).

The type of *Apis longicornis* Linnaeus, 1758 is a male preserved in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

129. *Melecta punctata* (Fab.).

Owing to the kindness of Dr. O. Schröder, I was sent specimens of *Apis punctata* Fabricius, 1775 from the Fabrician collection at Kiel. There was one female with Fabricius' label and three females and one male unlabelled. The labelled female agrees with the original description except that there is no white spot on the fifth tergite. All the specimens belong to *Melecta armata* (Panzer, 1799). I think the labelled specimen is probably the type and, as the species was described from England, it might have been expected to be *M. armata* rather than *M. luctuosa* (Scop.). Fabricius' name should be used.

130. *Epeolus variegatus* (L.).

The type of *Apis variegata* Linnaeus, 1758 is a male preserved in the Linnean collection at Burlington House. It belongs to *Epeolus productus* Thomson, 1870, as is shown by the structure of the labrum, the sparse puncturation of the top of the metapleuron, of the hind femur and of the second abdominal sternite.

131. *Nomada ferruginata* (L.).

In the Linnean collection at Burlington House is a female specimen of the above bee labelled "*ferruginata* ex. descr." in the handwriting of Sir J. E. Smith. This specimen agrees perfectly with the original description of *Apis ferruginata* Linnaeus, 1767; it may possibly be the type. It is a specimen of *Nomada ferruginata* (L.), as defined in Schmiedeknecht (1930, p. 958), which is the species British entomologists have recently called *N. germanica* (Panzer, 1799).

132. *Nomada ruficornis* (L.).

The type of *Apis ruficornis* Linnaeus, 1758 is a female preserved in the Linnean collection at Burlington House. It belongs to *Nomada bifida* Thomson, 1872, which should in future be known by this name. The original description of the species agrees better with this interpretation than with the usual erroneous one.

It is interesting to note that William Kirby (1802, p. 212) made in effect the same identification. Perkins (1917, *Ent. mon. Mag.*, **53**: 48) found that Kirby's numbered specimens (*i.e.* specimens regarded as non-varietal) were both *bifida.*

133. *Nomada ruficornis* Auctt. *nec* Linnaeus.

The correct name for this species is a matter of some difficulty. Von Dalla Torre places *Vespa rubra* Fourcroy, 1785 in the synonymy. The original description of this species runs as follows :—" La Gûepe rouge à bandes noires sur le corcelet et points jaunes sur le ventre. Long. 3½ lig. larg. 1 lig. *V. rubra*, thorace lineolis longitudinalibus nigris abdomine maculis flavis." I think it is impossible to say with any certainty which one species of *Nomada* is intended by the description. Another name placed in the synonymy is *Nomada affinis* Herrich-Schäffer, 1839. The type of this species is lost and in view of the numerous very closely allied species now recognised, I think the synonymy is necessarily very uncertain.

The next available names are those of a number of varieties proposed by Schmiedeknecht (1882, *Apidae Europeae*, **1**). These are varieties *mirabilis*, *phoenicea*, *trapeziformis*, *incompleta* and *hybrida*, in that order of priority. According to Stöckhert (*in* Schmiedeknecht, 1930, p. 1014), *mirabilis* = *N. signata* Jurine; *N. trapeziformis* is a distinct species; *phoenicea* is an aberrant variety of *N. ruficornis* Auctt. attached to *Andrena cingulata* (Fab.); *incompleta* and *hybrida* are varieties of the ordinary form of *N. ruficornis* Auctt. I propose, therefore, to adopt the name *N. incompleta* Schmiedeknecht, 1882 for *N. ruficornis* Auctt. *nec* Linnaeus.

134. *Nomada glabella* Thomson.

Perkins (1919, *Trans. ent. Soc. Lond.*, **1919** : 251) mentions a dark variety of *Nomada ruficornis* Auctt. found associated with *Andrena lapponica* Zett. in Scotland and on Dartmoor. On the Continent, *Nomada glabella* Thoms., a closely allied species, is recorded as a parasite of the same *Andrena* (Stöckhert *in* Schmiedeknecht, 1930, *Hymen. Mitteleurop.* (2nd ed.) : 1015, 1049). I have recently obtained a series of *N. glabella* captured in company with *A. lapponica* at Galtür, Paznauntal, Tirol, July '33. The year was an unusually late one, the snow lying long, and the bees were flying at 6000 ft. Prof. G. D. H. Carpenter lent me the series of the dark variety of *N. ruficornis* Auctt. from the Perkins coll. (now at Oxford) to compare with *N. glabella.* They must be regarded as a variety of *N. incompleta* (= *ruficornis*), though in some respects intermediate.

N. glabella ♀ differs most conspicuously from *N. incompleta* ♀ in the following particulars :—Flagellum of antennae more clearly darkened above ; clypeus with pale apical area narrower ; mesonotum black or with much narrower longitudinal red stripes ; red spots on mesopleuron and propodeum smaller or absent ; abdomen darker, yellow spots on second tergite lateral with the inner edge rounded, third and fourth tergites with very small or no spots ; wings darker ; pubescence of propodeum shorter and sparser.

In the Perkins collection there are fifteen Scottish females (Balerno, Colton, and New Park) and ten females from Devonshire (E. Dartmoor and Bovey Tracey) of the form of *N. incompleta* associating with *A. lapponica.* In all, except one Dartmoor female, the abdomen is darker than usual, with the yellow markings more or less reduced. Most specimens are like *N. incompleta* in the other characters, but there are some intermediates, and one specimen from Scotland (Colton) almost runs into *N. glabella.*

135. *Nomada rufocincta* (Kirby).

Stöckhert (*in* Schmiedeknecht, 1930) has recently shown that two species have been confused under the name *Nomada furva* Panzer, 1798. Only one of these species is found in Britain, viz. the one for which he uses the name *Nomada dalii* Curtis, 1832. An earlier name, however, is *Nomada rufocincta* (Kirby, 1802, p. 216) [= *N. sheppardana* (Kirby, 1802, p. 217)].

136. The months of publication of certain works appearing in 1802.

(*a*) Latreille, P. A., *Hist. nat. Fourmis*, Paris, An. X.
(*b*) Latreille, P. A. *Hist. nat. Crust. Ins.*, **3**, Paris, An. X.
(*c*) Walckenaer, C. A. *Fauna parisiensis*, 2 vols. Paris, An. XI.

A footnote in (*b*) (p. 369) shows that (*a*) had appeared in April. A remark in (*b*) on p. 369 shows that Kirby's *Monographia Apum angliae* was already out when (*b*) appeared. Kirby's preface was dated May 1st, 1802. Therefore, (*b*) appeared May–Sept., 1802 (An. X ending in Sept.). Walckenaer's work appeared in Oct.–Dec., 1802. Therefore, the three works appeared in the order, *a*, *b*, *c*. I am indebted to Mr. F. J. Griffin for the above facts.

137. *Ceratina cyanea* (Kirby).

Two different *Apis cyanea* were described in 1802, one by Kirby (*Monogr. Apum angliae*) and one by Turton (1802, *Linn. Syst. nat.* **3** : 542). The month of Turton's publication cannot be established and must be taken as December, whereas Kirby's work had appeared by July (see note 133). Therefore Kirby's name must stand.

138. *Megachile centuncularis* (L.).

A so-called type of *Apis centuncularis* Linnaeus, 1758 is preserved in the Linnean collection at Burlington House. The specimen is a female of *Megachile ligniseca* (Kirby, 1802). The label is not in Linnaeus' handwriting but on the reverse side of the label is the name "*rupestris*" in Linnaeus' handwriting. The label was probably one that had at some time become detached from *Vespa rupestris* Linnaeus, 1758. This species has never been traced, but it may be one of the unlabelled *Polistes* in Linnaeus' collection. At any rate, there is no reason why *Megachile centuncularis* of modern authors should not continue under this name. Kirby (1802, p. 240) already noticed that the "type" was probably not the specimen Linnaeus described.

139. *Megachile lagopoda* (L.).

The type of *Apis lagopoda* Linnaeus, 1761 is a male preserved in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

140. *Coelioxys quadridentata* (L.).

The type of *Apis quadridentata* Linnaeus, 1758 is a male preserved in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species. The type female of *Apis conica* Linnaeus, also preserved in the same collection, is a female of the same species.

141. *Coelioxys inermis* (Kirby).

The type of *Apis inermis* Kirby, 1802 is preserved in the British Museum collection. It is a male of *C. acuminata* Nylander, 1852. Kirby's name must stand.

142. *Anthidium manicatum* (L.).

The type of *Apis manicata* Linnaeus, 1758 is a male preserved in the Linnean collection at Burlington House. It agrees with the usual interpretation of the species.

143. *Stelis aterrima* (Panzer).

Apis aterrima Panzer, 1798 is preoccupied by *Apis aterrima* Christ, 1791. The next available name is *Apis punctulatissima* Kirby, 1802, which should be used.

144. *Osmia rufa* (L.).

The type of *Apis rufa* Linnaeus, 1758 is a male preserved in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species, belonging to the form with the abdominal pubescence red. The type female of *A. bicornis* Linnaeus, 1758, preserved in the same collection, is a female of *O. rufa* (L.).

145. *Osmia coerulescens* (L.).

The type of *Apis coerulescens* Linnaeus, 1758 is a female preserved in the Linnean collection at Burlington House. It is of the same species as that for which E. Saunders (1896) used the name. Modern authors have frequently used the name *Osmia aenea* (L.). The type male of *Apis aenea* Linnaeus, 1761, preserved in the same collection, is probably the male of *O. coerulescens*, though the abdomen is now lacking.

146. *Osmia leiana* (Kirby, 1802).

Two species were long confused under this name, but only one, which should be known by the above name, is found in Britain. *Osmia hirta* Smith, 1844 is a synonym.

The other species is commonly known as *Osmia fulviventris* (Panz.), but *Apis fulviventris* Panzer, 1798 is preoccupied by *Apis fulviventris* Scopoli, 1763 (an unrecognised species of *Sphecodes*). *O. fulvicornis* Latreille, given as a synonym by Von Dalla Torre in his Catalogue, is a misprint in the catalogue. The correct name would appear to be *Osmia ventralis* (Panzer) = *Apis ventralis* Panzer, 1798. *O. atra* Schenck, 1853 may be a synonym, but, according to information sent to Mr. N. D. Riley by Dr. Alverdes, the type no longer exists in Schenck's collection at Marburg.

147. *Heriades truncorum* (L.).

The type of *Apis truncorum* Linnaeus, 1758 is a female in the Linnean collection at Burlington House. It agrees with the usual modern interpretation of the species.

148. *Heriades florisomnis* (L.) and *H. campanularum* (K.).

The type of *Apis florisomnis* Linnaeus, 1758 is male preserved in the Linnean collection at Burlington House. It belongs to the species for which E. Saunders (1896) used the name. The type of *Apis maxillosa* Linnaeus, 1767 is a female of the same species, preserved in the same collection.

Aurivillius (1927, *Ent. Tidskr.*, **41** : 143–4) has argued from the descriptions that *Apis florisomnis* L. = *A. campanularum* Kirby, 1802. As shown above, this is incorrect. Kirby (see 1802 : 254, line 1), before describing his *Apis campanularum* had already seen the Linnean type of *A. florisomnis*.

149. *Bombus donovanella* (K.).

The type of *Apis donovanella* Kirby, 1802 is preserved in the British Museum. It is a male of *Bombus ruderarius* (Müller, 1776) [= *derhamellus* (Kirby, 1802)].

Perkins (1919, *Ent. mon. Mag.*, **55** : 11) has stated that *Apis donovanella* is the same as *A. cullumana* Kirby, 1802, but this is incorrect.

150. *Bremus truncorum* Panzer, 1801.

The type of *Bremus truncorum* Pz., is in Sturm's collection at Munich. It was lent by Baron K. von Rosen and is a male of *Bombus lapidarius* Linnaeus, 1758.

151. The Linnean types of *Bombus*.

The type females of the following species, described in 1758 as *Apis*, are preserved in the Linnean collection at Burlington House and agree with the usual modern interpretation of the species :—*hypnorum*, *lapidaria* and *terrestris*.

The types of the following species described in 1761 are preserved in the same collection and agree with the usual modern interpretation of the species :—*sylvarum* (☿), *lucorum* (♂), *hortorum* (♂), *pratorum* (☿).

The type of *Apis muscorum* Linnaeus, 1758 has already been discussed by me elsewhere (1935, *Trans. Soc. Brit. Ent.*, **2.**). I propose to continue to use the name *B. muscorum* (L.) for the species commonly known by that name.

152. *Apis mellifera* (L.).

The type of *Apis mellifera* Linnaeus, 1758 is a male in the Linnean collection at Burlington House. The type of *Apis mellifica* Linnaeus, 1761 is a worker in the same collection. Both agree with the usual interpretation of the species, but the earlier name should be used.

THE MUTILLID WASPS OF THE ISLANDS OF THE PACIFIC OCEAN (HYMENOPTERA; MUTILLIDAE) *

By Clarence E. Mickel, M.Sc., Ph.D.

(*University of Minnesota.*)

[Read 2nd October, 1935.]

The study of the Mutillid fauna of the islands of the Pacific Ocean received its first impetus approximately eighty years ago when the eminent naturalist, Alfred Russel Wallace, spent several years in the East Indian Islands collecting specimens and gathering data regarding the geographical distribution of animals. The insect specimens collected by Wallace were returned to England, where they became a part of the collections of the entomologist, W. W. Saunders. The Hymenoptera from this material were studied by Frederick Smith of the British Museum (Natural History), who published the results of his studies in a series of papers in the Journal of the Proceedings of the Linnean Society of London. Smith states in one of these papers (1864) that three hundred and fifty species of Mutillidae are known from the world, and catalogues thirty-seven species from the East Indian Islands; nearly all of the latter he had described as new from the material collected by Wallace. During the seventy years which have followed, the described Mutillid fauna of the world has increased at least ten-fold; that of the Pacific Islands has increased about eight-fold. The present paper treats of two hundred and seventy-four species and subspecies belonging to nine genera, and includes the fauna of Japan, Formosa, the Philippines and the Oceanic Islands, as well as the Lower Malay Peninsula.

Wallace (1873) realised that the Hymenopterous fauna of the East Indian Islands had only been sampled, for he wrote, " Even the best collections I have been able to make can only be looked upon as samples of the productions of these luxuriant regions. A traveller can do no more than test the productiveness of a country; and we shall never know all the riches of the eastern forests till some assiduous entomologist has devoted several years to a single island." This suggestion regarding intensive collecting on single islands has been carried out only in two instances with reference to the Mutillid wasps. Herr H. Sauter in Formosa and Professor C. F. Baker in the Philippine Islands were indefatigable collectors and amassed great quantities of material from their respective regions. As a result of their collecting year after year the Formosa Mutillid fauna now numbers thirty-eight species and subspecies, while that of the Philippines has reached a total of sixty-nine. On the other hand, only a comparatively small quantity of Mutillid material is available for study from Japan, Borneo, Java, Sumatra, Timor, Celebes, Ceram, Gilolo and New Guinea, although there is enough to indicate the richness of the fauna. Were quantitative collecting carried out in all of these islands the number of species and subspecies would undoubtedly be still greatly increased. A geographical catalogue of the species and subspecies now known from the Pacific Islands is included in this contribution.

The study of the geographical distribution of insects is complicated by the varied abilities of these animals to cross natural barriers, due to variations in power of flight, specific gravity, and ability to survive on all sorts of material

---

* Paper No. 1268 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.

TRANS. R. ENT. SOC. LOND. 83. PART II. (NOV. 1935.) N

floating in water. The negative nature of these characteristics in mammals was a factor which led Wallace to select that group as a basis for his study of the zoogeography of the Malay Archipelago. He stated, " It is evident that the Mammalia have scarcely any means for voluntarily passing from island to island over straits of the sea from twenty to fifty miles wide, or even for a much less distance; and they are scarcely likely to be accidentally carried to sea in large numbers, so as to give a chance of a few swimming over to adjacent islands and there establishing themselves." Wallace attempted in a limited way to verify the conclusions he reached with respect to the distribution of Mammalia by comparing the latter with the distribution of the Hymenoptera in the same region. He selected the ants among the Hymenoptera in order to minimise the factors of flight, possibility of being blown by the wind, etc. The conclusions he reached after a study of the ants agreed in general with those reached from his study of the Mammalia.

Water barriers are probably more effective in restricting the geographic distribution of ants than is the case with most other Hymenoptera, but they are of still greater efficiency in the case of the Mutillid wasps. This is true for the following reasons: Mutillid females are *always* wingless so that the factor of flight as a means of dispersion of species is entirely eliminated; Mutillid wasps are solitary and their habits are such that the possibility of a species being transported from one island to another on floating debris is exceedingly remote; the females in addition to being wingless are compact, heavily sclerotised and comparatively heavy so that there is almost no possibility of them being blown any great distance by wind; and finally, should a fertile female Mutillid succeed in passing from one island to another in spite of these obstacles, the species could only survive if it was able to find a suitable insect host, since so far as is known Mutillids are parasites of other insects, principally wasps and bees. That the above conditions are really effective in nature and prevent the spread of Mutillid species from island to island is demonstrated by the fact that no Mutillid wasps are known from any oceanic islands in the world; in the Pacific they are absent from the Hawaiian Islands and all the Polynesian Islands. On the other hand, they are present in all of the Pacific continental islands with the exception of New Zealand. At the present time the most eastern Pacific Islands from which they are known are the Solomon Islands and New Caledonia. Since Mutillid wasps are absent from all the oceanic islands the conclusion must be that these wasps are not able to extend their geographical range by chance migrations from island to island. If that be true, then the present geographical distribution of Mutillids on continental islands must have come about by some other process. The only other satisfactory alternative is that the Mutillids have spread over the Pacific Islands at some time in the geologic past when they were connected by land with each other and to the Asiatic or Australian continents. This was the explanation proposed by Wallace for the distribution of mammals in this region. Wallace's study of the mammals led him to the conclusion that the mammalian fauna of Sumatra, Java and Borneo was Indo-Malayan in character, while that of Celebes, Ceram, Timor, Gilolo and New Guinea was Australian in character.

All of the Mutillid genera represented in the Pacific Islands are Asiatic, except the single genus *Ephutomorpha*, which is Australian. It is interesting to note that all of the Pacific Islands from which Mutillids have been recorded, with the exception of Mysol, Waigiou and New Caledonia, have Asiatic genera represented in their Mutillid fauna. This is true even for Australia itself, where species of *Timulla* (*Trogaspidia*) and *Odontomutilla* are found. The genus

Ephutomorpha is the only one known from New Caledonia, Waigiou and Mysol. Twenty-three species of Mutillids are recorded from New Guinea, of which fifteen belong to *Ephutomorpha*, so that the Mutillid fauna of that island is predominantly Australian. The same is true for Ceram, where three out of five species belong to *Ephutomorpha.* Wallace found the fauna of Celebes to be predominantly Australian in its affinities, but although eighteen species of Mutillids are known from this island not a single one belongs to *Ephutomorpha*; thus as far as the MUTILLIDAE are concerned the affinities of the Celebes fauna are Asiatic. The Pacific Islands from which the Australian genus *Ephutomorpha* is known are New Caledonia, Solomon Islands, New Guinea, Waigiou, Mysol, Aru, Ceram, Amboina and Sumbawa.

The distribution of the Asiatic genera in the islands is also of interest. The genera *Mutilla* and *Cystomutilla* are represented only in Japan. The single subspecies *Mutilla europaea* subsp. *mikado* Cameron found in Japan is so nearly like the European subspecies that there is difficulty in separating the two. The genus *Cystomutilla* previously included only a single species from Europe; a second from Japan is described in this paper. The genus *Rhopalomutilla* has previously been known only from Africa; undescribed species of this genus are known from India, and a new species from Borneo is described herein. The genus *Myrmilla* is represented in this region by a single species in Formosa doubtfully referred to it. The genera *Squamulotilla, Odontomutilla, Timulla* (*Trogaspidia*) and *Smicromyrme* are widely distributed in the Pacific Islands. The following table shows the geographical distribution of genera for the entire region.

Distribution of Genera of MUTILLIDAE *in the Pacific Islands.*

	Japan.	Formosa.	Philippines.	Borneo.	Malay Pen.	Sumatra.	Java.	Celebes.	Morty.	Gilolo.	Bachian.	Sumbawa.	Amboina.	Ceram.	Larat.	Kei.	Aru.	Mysol.	Waigiou.	New Guinea.	New Britain.	Solomon Is.	N. Caledonia.
Myrmilla Wesmael.		×																					
Squamulotilla Bischoff	×	×	×	×	×	×	×	×															
Rhopalomutilla André				×																			
Cystomutilla André	×																						
Mutilla L.	×																						
Odontomutilla Ashmead		×	×	×	×	×	×	×		×	×			×			×			×			
Timulla (*Trogaspidia*) Ashmead	×	×	×	×	×	×	×	×			×	×	×	×	×	×	×			×	×	×	
Smicromyrme Thomson	×	×	×	×	×		×	×	×		×												
Ephutomorpha André												×	×	×			×	×	×	×		×	×

Certain conclusions are inevitable from these facts; *i.e.* (1) The genera *Timulla* (*Trogaspidia*) and *Odontomutilla* appear to be the oldest genera and have spread from Asia to all the East Indian Islands, excepting New Caledonia, at some time in the geologic past when all were connected; dispersal proceeded from Asia eastward, since the number of species present in each island becomes less and less from the Malay Peninsula to New Guinea. (2) After the establishment of the above genera in the region as far east as New Guinea a separation took place between Java, Celebes and Gilolo on the one side, and Sumbawa, Amboina, Ceram and New Guinea on the other. At the same time or somewhat later the New Guinea area then became connected with Australia; thereupon the feeble fauna of *Timulla* (*Trogaspidia*) and *Odontomutilla* present in the New Guinea area invaded and established a very few species in Australia, while the much stronger Australian fauna, the genus *Ephutomorpha*, was dispersed over the New Guinea and adjacent areas. Later these areas were again separated from Australia. (3) The genera *Squamulotilla* and *Smicromyrme* invaded the East Indian Islands later than *Timulla* (*Trogaspidia*) or *Odontomutilla* after the separation of New Guinea and adjacent areas from the Asiatic continent, so that they were not able to advance eastward farther than Celebes and Bachian. The genus *Rhopalomutilla* appears to be a late arrival in the East Indian Islands dispersed from Africa by way of India and the Malay Peninsula. The genera *Cystomutilla, Mutilla* and *Myrmilla* are also late arrivals in Japan and Formosa from northern Asia. No specimens of fossil Mutillidae are known which can be used for assigning definite periods of geologic time for these events, but the sequence of the dispersals appears to be well established. The Australian fauna, genus *Ephutomorpha*, is very different from the Asiatic fauna and appears to have had its origin independently from the latter. Very close relationships exist between the Australian and South American faunas of Mutillidae.

Species and subspecies of Mutillidae in the Pacific Islands are in most cases restricted to single islands, or in the case of the Philippines to groups of islands. The instances where a single species is present in two or more different islands without any subspecific differentiation are so rare that the specific and subspecific distinctness of the fauna of each island may be taken as axiomatic. The Philippine Islands may be divided into six geographic regions, some of which are groups of islands. The distribution of Mutillids in the Philippine Islands has been discussed by Mickel (1934). Excepting the Philippine Islands where enough Mutillid material has been available to give more refined details regarding the distribution of these wasps in that area, there are only seventeen species or subspecies of Mutillidae which are common to two or more islands in the Pacific region. They are as follows :

Squamulotilla sulpicilla Mickel	Philippines and Borneo.
Squamulotilla deserta (Smith)	Philippines and Celebes.
Odontomutilla familiaris subsp. *familiaris* (Smith)	Philippines, Borneo and Malay Pen.
Odontomutilla manifesta (Smith)	Aru and New Guinea.
Timulla (*T.*) *wallacei* subsp. *wallacei* (Ckll.)	Aru and New Guinea.
Timulla (*T.*) *disparilis* Mickel.	Japan, Formosa and Hainan.
Timulla (*T.*) *concava* Mickel	Japan and Formosa.
Timulla ianthea subsp. *rubiginosa* (André)	Amboina and Ceram.
Timulla (*T.*) *repraesentoides* Mickel	Formosa and China.
Timulla (*T.*) *circumcincta* (André)	Sumatra and Malay Pen.
Timulla (*T.*) *proserpina* subsp. *proserpina* (Smith)	Philippines and Borneo.
Smicromyrme basalis subsp. *basalis* (Smith)	Philippines and Borneo.
Smicromyrme bakeri Mickel	Philippines and Borneo.
Smicromyrme fluctuata (Smith)	Philippines and Morty Island.
Smicromyrme zebina (Smith)	Philippines, Borneo and Bachian.
Ephutomorpha curta (André)	Amboina and Ceram.
Ephutomorpha mirabilis (Smith)	Waigiou and New Guinea.

A number of species of Mutillidae have been recorded in the past as having a wide distribution in the Pacific Island region, even some Indian species being recorded as occurring there. This has been due to an over-emphasis on similarities between species and either a failure to recognise differences or the minimising of differences as unimportant variations. This has been done to such an extent that most of the records of MUTILLIDAE from the Pacific Islands, other than original descriptions, are invalidated. The technique of taxonomy demands a precise discrimination of differences as well as the recognition of similarities. Both are of equal importance. The Pacific Islands are of especial interest with reference to MUTILLIDAE because of the many isolated faunas with possibilities for intermixing reduced to a minimum. Small differences between related forms in this region are nearly always correlated with isolation on specific islands or groups of islands, thus giving weight to the conclusion that such differences are of value as subspecific and specific characters. An attempt has been made to eliminate all invalid records based on misidentifications by either re-examining the material on which such records were based or excluding them from consideration entirely. All the records of species included herein are based on identifications which have been verified by re-examination, by study of type specimens, or by comparison with type specimens. Many of the records which have been excluded from this study, because the material was not available for examination, are probably examples of undescribed species which have been misidentified and recorded as known species. The following Australian species are recorded from New Guinea and Morty Island but are omitted because undoubtedly the specimens on which the records are based are really examples of new and undescribed species :

Mutilla (*Sphaerophthalma*) *morosa* André, 1896, *Ann. Mus. civ. Genova*, (2) **17** : 91, ♂.

Ephutomorpha ferruginata var. *melanota* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 103, ♀.

This contribution is the outgrowth of a study of the MUTILLIDAE of the Philippine Islands initiated several years ago. A competent study of the Philippine material necessitated comparison with other species described from surrounding regions. The results of these various investigations are now brought together in a single paper. All of the types of previously described species, with a few exceptions noted hereafter, have been examined and the keys have been constructed during the examination of the types.

The author is deeply indebted to the John Simon Guggenheim Memorial Foundation, New York, for the opportunity of studying in Europe where nearly all the type material is located. Thanks and appreciation are also due to the following individuals and institutions for the privilege of studying type specimens and other type material in their charge : Professor E. B. Poulton, Hope Museum, University of Oxford, England; Major E. E. Austen, Dr. Hugh Scott and Mr. Robert B. Benson, British Museum (Natural History), London ; Dr. Carl Zimmer, Director, and Dr. H. Bischoff, Zoologisches Museum der Universität, Berlin; Dr. Walther Horn, Director, Deutsches Entomologisches Institut, Berlin-Dahlem; Dr. L. Berland, Muséum nationale d'Histoire naturelle, Paris; Dr. A. Arcangeli, Director, Museo Zoologia et Anatomia comparata della R. Universita, Turin; Dr. L. Masi, Museo Civico di Storia Naturale, Genoa; Hungarian National Museum, Budapest; Naturhistorisches Staatsmuseum, Vienna; Zoölogisch Museum, Amsterdam; and Rijks Museum van Naturlijke Historie, Leiden.

Key to the Genera.

♂♂.

1. Eyes distinctly ovate, only moderately convex, the inner margin emarginate or not . . . . 2.

Eyes distinctly circular or subcircular, strongly convex, never emarginate within . . . . *Ephutomorpha* André.
2. Second abdominal tergite with a distinct felt line, near and parallel to the lateral margin . . . . 3.
Neither the second tergite nor the second sternite with lateral felt lines *Rhopalomutilla* André.
3. Tegulae small, scale-like, convex, smooth and shining, the hind margin not reflexed . . . . 4.
Tegulae large, the hind margin reflexed, or if not then the tegulae coarsely punctured . . . . 5.
4. Abdominal tergites 2–5 with a distinct, median, longitudinal carina *Squamulotilla* Bischoff.
Abdominal tergites 2–5 without a median, longitudinal carina *Myrmilla* Wesmael.
5. First abdominal segment evenly sessile, the first tergite evenly rounded into the second . . . . 7.
First abdominal segment strongly transverse, the first tergite with distinct dorsal and anterior faces . . . . 6.
6. Postero-lateral angles of scutellum produced, thus more or less dentate *Odontomutilla* Ashmead.
Postero-lateral angles of scutellum rounded, not produced or dentate *Mutilla* L.
7. Vertex not at all elevated posteriorly, not flattened, rounded throughout, the posterior margin not truncate, punctate throughout, without any trace of longitudinal striae; distance between the origin of vein *M* on vein *R* and the base of the stigmatic cell scarcely greater than the length of the stigmatic cell . . . . *Timulla* (*Trogaspidia*) Ashmead.
Vertex elevated posteriorly, more or less flattened, truncate posteriorly at the middle, distinctly longitudinally striato-punctate throughout; distance between origin of vein *M* on vein *R* and the base of the stigmatic cell almost equal to twice the length of the latter . . *Smicromyrme* Thomson.

♀♀.

1. Eyes distinctly ovate, only moderately convex . . . . 3.
Eyes distinctly circular or subcircular . . . . 2.
2. Eyes small, moderately convex; Japanese species . . *Cystomutilla* André.
Eyes large, strongly convex, almost hemispherical; species from New Guinea and vicinity. . . . . *Ephutomorpha* André.
3. Mesopleurae with a very prominent, vertical, lamelliform projection just above the middle coxae . . . . 4.
Mesopleurae without such a vertical, lamelliform projection . . . . 5.
4. Head very large, usually broader than the thorax, quadrate, strongly developed behind the eyes . . . . *Myrmilla* Wesmael.
Head smaller, not broader than the thorax, not quadrate, only moderately developed behind the eyes . . . . *Squamulotilla* Bischoff.
5. Second abdominal tergite with a distinct felt line, near and parallel to the lateral margin . . . . 6.
Neither the second tergite nor the second sternite with lateral felt lines *Rhopalomutilla* André.
6. Thorax more or less hexagonal, the sides converging anteriorly and posteriorly . . . . *Odontomutilla* Ashmead.
Thorax rectangular or subrectangular, the sides approximately parallel . 7.
7. First abdominal segment evenly sessile, not strongly transverse, the first tergite evenly rounded into the second . . . . 8.
First abdominal segment strongly transverse, the first tergite with distinct dorsal and anterior faces . . . . *Mutilla* L.

8. Second abdominal tergite ornamented with a pair of anterior, pale pubescent spots transversely arranged, or sometimes entirely immaculate, without pale pubescent spots and without an apical, pale pubescent fringe; if second tergite immaculate, the integument entirely black *Timulla* (*Trogaspidia*) Ashmead.
   Second abdominal tergite ornamented with unpaired pale pubescent spots, sometimes a single median spot, sometimes three spots arranged transversely, or if without anterior, pale pubescent spots, then the abdomen dark metallic blue and the second tergite with an apical fringe of pale pubescence . . . . *Smicromyrme* Thomson.

Myrmilla Wesmael.

Myrmilla hoozana Zavattari.

Myrmilla hoozana Zavattari, 1913, *Arch. f. Naturges.*, **79a** (3) : 22, ♂.
Myrmilla hoozana Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 383, ♂.

Lectotype.—♂, Hoozan, iv.1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Squamulotilla Bischoff.

Key to the Species.

♂♂.

1. Wings with one cubital cell, cells R_4 and R_5 both absent . . . . . . 2.
   Wings with two cubital cells, only cell R_4 absent . . . . 7.
2. Lateral margins of pronotum prominently angulate medially; at least the second tergite with a narrow, pale yellow, transverse, integumental stripe at the apical margin medially . . . . 3.
   Lateral margins of pronotum very indistinctly, or not at all, tuberculate medially; second tergite uniformly metallic blue or violaceous throughout 4.
3. Second, third and fourth tergites with a narrow, pale yellow, integumental stripe at the apical margin, not extending to the lateral margins *muiri* sp. n.
   Only the second tergite with a narrow, pale yellow, integumental stripe at the apical margin . . . . *facilis* (Smith).
4. Lateral margins of pronotum with a small, median tubercle; second tergite with moderate, distinct punctures, for the most part separated by their own diameter . . . . *ocypote* Mickel.
   Lateral margins of pronotum not tuberculate medially; second tergite usually more sparsely punctate, the punctures separated by from one to three times their own diameter . . . . 5.
5. Lateral margins of pronotum straight, not at all sinuate; punctures of second abdominal tergite separated by about three times their own diameter . . . . *dictynna* Mickel.
   Pronotum narrowed anteriorly, the lateral margins not forming a straight line but more or less sinuate; punctures of second abdominal tergite for the most part separated by one to two times their own diameter . . . 6.
6. Sides of propodeum with small, distinct punctures; second abdominal tergite with small punctures separated by one to two times their own diameter *imparilis* Mickel.
   Sides of propodeum distinctly reticulate; second abdominal tergite with fine punctures separated by two to three times their own diameter *disjuncta* Mickel.
7. Entirely black, or metallic blue-black . . . . 8.
   At least the thorax more or less ferruginous . . . . 12.

8. Second sternite with a median, longitudinal carina terminating posteriorly in a large, submarginal, blunt tubercle . . . . . . *tumidula* Mickel.
Second sternite either entirely without a median, longitudinal carina, or if the latter is present, then only on the anterior half of the sternite, and never terminating in a tubercle . . . . 9.
9. Second abdominal sternite conspicuously concave, glabrous, impunctate *concava* Mickel.
Second abdominal sternite convex, not at all concave . . . . 10.
10. First abdominal sternite with a distinct, well-developed, median, longitudinal carina; lateral margins of pronotum, each with a distinct, median tubercle . . . . *umbrosa* Mickel.
First abdominal sternite without a median, longitudinal carina; lateral margins of pronotum very slightly angulate medially but without a distinct, median tubercle . . . . 11.
11. Hypopygium with a conspicuous, transverse, arcuate carina at its proximal margin; length, 9 mm. . . . . *roxane* Mickel.
Hypopygium with a very feeble, transverse, arcuate carina at its proximal margin; length, 5 mm. . . . . *subdebilis* Mickel.
12. Hypopygium conspicuously elevated medially or at the sides . . . . 15.
Hypopygium only very feebly elevated at the base . . . . 13.
13. Anterior margin of clypeus broadly and deeply emarginate, thus appearing bidentate . . . . *clypealis* sp. n.
Anterior margin of clypeus not emarginate . . . . 14.
14. First sternite with a distinct, median, longitudinal carina; hypopygium with a small, inconspicuous tubercle at each antero-lateral angle *eminula* Mickel.
First sternite without a median, longitudinal carina; hypopygium with a feeble, transverse carina near the proximal margin . . *sulpicilla* Mickel.
15. Second sternite with a prominent, median, elongate elevation on the apical half; abdomen entirely blackish . . . . . . *formosana* (Zavattari).
Second sternite evenly convex on the apical half, not at all elevated medially . . . . 16.
16. Hypopygium with a conspicuous, transverse, arcuate carina at the proximal margin . . . . 17.
Hypopygium with a pair of elevated, sharp, converging carinae near the lateral margins; humeral angles rounded . . . . . *palaca* (Cameron).
17. Second tergite with a narrow, transverse, median, integumental band at the apical margin, pale yellow; thorax including the tegulae pale ferruginous . . . . *calliopeia* sp. n.
Second tergite entirely black; thorax more or less ferruginous but at least the tegulae dark brown to black . . . . 18.
18. Thorax largely ferruginous; sometimes the mesonotum and scutellum black *teuta* subsp. *teuta* Mickel.
Thorax largely blackish; only the metapleurae and propodeum ferruginous *teuta* subsp. *vicinaria* Mickel.

♀♀.

1. Propodeum with a transverse row of long, vertical teeth at the junction of the posterior and dorsal surfaces . . . . 14.
Propodeum slightly serrate, but without a transverse row of long, vertical teeth at the junction of the posterior and dorsal surfaces . . . . . . 2.
2. Genae armed with a strong, spinose tubercle . . . . *arundinacea* Pagden.
Posterior margin of genae sometimes slightly serrate, but not with a spinose tubercle . . . . 3.
3. Median spot on first tergite and apical band of second tergite white, the colour integumental and pubescent . . . . 4.

Median spot on first tergite and apical band of second tergite white, the maculations formed only by silvery pubescence . . . . 12.

4. Dorsum of propodeum with a prominent, median tooth . . . . . . 5.

Dorsum of propodeum without a median tooth, at the most with a transverse, slightly serrate carina at the posterior margin . . . . . . 9.

5. Fourth abdominal tergite with a median spot of pale pubescence *saffica* (Zavattari).

Fourth abdominal tergite entirely black pubescent . . . . 6.

6. Lateral margins of mesonotum dentate; dorsum of thorax densely, confluently punctate, not at all longitudinally striato-punctate; posterior face of propodeum densely punctate . . . . . . *erdae* (Zavattari).

Lateral margins of mesonotum not dentate, at the most slightly crenulate or tuberculate; dorsum of thorax distinctly, longitudinally striato-punctate; posterior face of propodeum with scattered punctures . . 7.

7. Mesopleural process well developed, conspicuous, the distal margin rounded; sides of propodeum glabrous, impunctate; fifth tergite with a median spot of pale pubescence; distal half of femora, tibiae and tarsi, black *byblis* Mickel.

Mesopleural process only moderately developed, the distal margin straight, truncate; sides of propodeum with small, distinct punctures; fifth tergite not maculated with pale pubescence; legs entirely ferruginous . 8.

8. Lateral margins of pronotum with a conspicuous, median, angulate tubercle; sides of propodeum with small, close punctures; distal, external spine of hind tibiae not at the end of a cylindrical process . . . *venatrix* sp. n.

Lateral margins of pronotum not dentate or tuberculate, except humeral angles acute; sides of propodeum with small, scattered punctures; distal, external spine of hind tibiae at the end of a short cylindrical process . . . . *cardea* sp. n.

9. Lateral margins of mesonotum conspicuously dentate . . . . 10.

Lateral margins of mesonotum feebly crenulate or denticulate . . . . 11.

10. Mesonotum with a distinct, median, longitudinal carina; scape and at least the tibiae blackish . . . . *multidentata* (André).

Mesonotum without a median, longitudinal carina; scape and legs entirely ferruginous . . . . *fucosa* Mickel.

11. Mesopleural process very large, distinctly longer than high, subtriangular, conspicuous; coxae, trochanters and proximal third of femora, ferruginous . . . . *subtriangularis* Mickel.

Mesopleural process only moderately developed, only half as long as high, subrectangular; trochanters and femora entirely black . *galatea* Mickel.

12. Third tergite entirely black pubescent . . . . 13.

Third tergite with an apical band of pale pubescence . *carinulifera* (André).

13. Head entirely black; tergite 5 clothed entirely with black pubescence *ardescens* (Smith).

Head largely ferruginous; apical margin of tergite 5 with a band of appressed, silvery pubescence . . . . *aesyca* (Cameron).

14. Median spot on first tergite and apical band of second tergite white, the colour integumental . . . . 15.

Median spot on first tergite and apical band of second tergite pale, the maculations formed by silvery or golden pubescence . . . . . . 18.

15. Thorax either slightly longer, or distinctly longer than broad . . . . 16.

Thorax distinctly as broad as long; dorsum of thorax with small, dense, contiguous punctures, without a median, longitudinal carina *oblectabilis* Mickel.

16. Lateral margins of pro-, and mesonotum straight, not dentate or denticulate; dorsum of thorax longitudinally rugoso-punctate *opipara* (Zavattari).

Lateral margins of dorsum of thorax strongly dentate and denticulate; dorsum of thorax longitudinally rugoso-punctate or not . . . . . 17.

17. Dorsum of thorax with an obscure, longitudinal, median carina on the anterior half; moderately, longitudinally rugoso-punctate *trituberculata* Mickel.

Dorsum of thorax with a distinct, median, longitudinal carina, with moderately small, dense, confluent punctures . . . *malica* (Zavattari).

18. Tergites 3–5 maculated medially with silvery or golden pubescence . . 19.

Tergites 3–5 entirely black . . . . *selangorensis* Pagden.

19. Posterior margin of genae with a distinct, dentate carina *perakensis* Pagden.

Posterior margin of genae without a distinct, dentate carina . . . . 20.

20. Tergites 3–5 each with a small, apical, median spot of pale pubescence *deserta* (Smith).

Tergites 3–5 each with a large, transverse, median spot of pale pubescence *sauteri* (Zavattari).

Squamulotilla facilis (Smith).

Mutilla facilis Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 76, ♂.
Mutilla facilis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 39, ♂.
——— *facilis* André, 1903, *Gen. insect.*, **11** : 70, ♂.

Holotype.—♂, Celebes, in Saunders' coll., Hope Dept. Oxford University.

Only the unique type seen. The following characters may be mentioned in addition to those given in the original description: Front wings with only a single cubital cell, both R_4 and R_5 absent; first segment of flagellum distinctly shorter than the second; and only the second abdominal tergite with a narrow, pale stripe at the apical margin medially.

Squamulotilla muiri sp. n.

♂. Head and abdomen black; thorax entirely, coxae and trochanters pale ferruginous; femora apically, tibiae and tarsi blackish; lateral margins of pronotum with a distinct tooth; second, third and fourth abdominal tergites each with a narrow, apical, pale yellow band, the colour integumental and not extending to the lateral margins; hypopygium with a distinct, arcuate, transverse carina near the anterior margin; wings with a single cubital cell, R_4 and R_5 both absent. Length, 6 mm. *Head* black, except the apical half of mandibles, and clypeus tinged with ferruginous; head clothed throughout with sparse, erect, pale pubescence; mandibles slender, acute at the apex and with two teeth within near the apex; clypeus somewhat convexly elevated, the anterior margin of the elevated area slightly crenulate; scape and pedicel dark, slightly tinged with ferruginous, the flagellum blackish; scape not carinate beneath; first segment of flagellum slightly but distinctly shorter than the second; antennal scrobes distinctly carinate above; front, vertex and genae with small punctures, distinct and well separated on the front, close and more or less confluent on the vertex and genae; relative widths of head and thorax including the tegulae, 2·3–2·4. *Thorax* entirely pale ferruginous, clothed throughout with sparse pubescence, that on the dorsal areas pale fuscous, on the propodeum long and pale, on the pleural areas pale, the mesopleurae with the pubescence thicker than elsewhere; pronotum, mesonotum and scutellum with moderately small, close, more or less confluent punctures; humeral angles angulate; lateral margins of pronotum with a distinct, small, median tooth; dorsum, posterior face and sides of propodeum all distinctly reticulate and each rounded into the other, the dorsum with a median, enclosed space slightly longer than broad; propleurae defined anteriorly by a sharp carina, apparently glabrous and impunctate; mesopleurae elevated ventrally and dorsally, the two areas separated by a deep furrow, the ventral area indistinctly punctate, the dorsal area with moderately small, close punctures; metapleurae glabrous, impunctate; tegulae pale ferruginous, small, subcircular, indistinctly punctate and with pale pubescence. *Abdomen* black, except the first segment anteriorly tinged with ferruginous, and the second, third and fourth tergites each with a narrow, pale yellow, apical band, the colour integumental and not extending to the lateral margins; abdomen clothed throughout with sparse, erect, pale pubescence; first tergite with small, very sparse punctures, the latter separated by a distance two to three times their own diameter; second tergite with small punctures, the latter close anteriorly, becoming sparse medially, posteriorly and laterally; tergites three to six with small, close but separated punctures; last tergite impunctate along the longitudinal median line, with dense, small punctures laterally; first and second sternites not visible in the holotype, the second apparently evenly convex throughout; sternites three to six with small, distinct punctures posteriorly; hypopygium with a distinct, arcuate, transverse carina near the anterior margin. *Coxae* and trochanters ferruginous; femora blackish, the proximal half tinged with ferruginous; tibiae and tarsi black; legs clothed throughout with sparse, pale pubescence; calcaria pale. *Wings* subhyaline; cell 2nd $R_1 + R_2$ large, triangular in outline, acute at the apex; cells R_4 and R_5 both absent.

Holotype.—♂, JAVA: Buitenzorg (*F. Muir*), in collection of University of Minnesota.

Closely related to *facilis* (Smith) but differs in having pale, narrow, apical bands on tergites three and four as well as on tergite two.

Squamulotilla ocypote Mickel.

Squamulotilla ocypote Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 114, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Malinao, Tayabas Province, Luzon (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla dictynna Mickel.

Squamulotilla dictynna Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 115, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Tangcolan, Bukidnon Province, Mindanao (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla imparilis Mickel.

Squamulotilla imparilis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 117, pl. 1, fig. 1, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla disjuncta Mickel.

Squamulotilla disjuncta Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 118, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Baguio, Benguet Province, Luzon (*Baker*), in United States National Museum.

Distribution.—Mt. Makiling, Luzon, in addition to type locality.

Squamulotilla tumidula Mickel.

Squamulotilla tumidula Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 384, ♂.

Holotype.—♂, FORMOSA: Taihorin, May, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from the type locality.

Squamulotilla formosana (Zavattari).

Myrmilla formosana Zavattari, 1913, *Arch. f. Naturges.*, **79A** (3) : 21, ♂.
Squamulotilla formosana Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 386, ♂.

Lectotype.—♂, FORMOSA : Kankau (Koshun), v.1912 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Formosa.

Squamulotilla concava Mickel.

Squamulotilla concava Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 120, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Tangcolan, Bukidnon Province, Mindanao (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla roxane Mickel.

Squamulotilla roxane Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 122, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Cuernos Mts., Negros (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla subdebilis Mickel.

Squamulotilla subdebilis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 123, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Los Banos, Luzon, 1917 (*F. X. Williams*), in University of Minnesota.

Distribution.—Known only from the type locality.

Squamulotilla sulpicilla Mickel.

Squamulotilla sulpicilla Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 125, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Dapitan, Mindanao (*Baker*), in United States National Museum.

Specimens examined.—NORTH BORNEO : ♂, Sandakan (*Baker*) ; ♂, Kudat, September 15, 1927 (*C. B. K.* and *H. M. P.*).

Both of the Borneo specimens have been compared with the holotype and found to be identical.

Squamulotilla palaca (Cameron).

Mutilla palaca Cameron, 1902, *J. Straits Br. R. Asiat. Soc.*, **37** : 80, ♂.

Holotype.—♂, BORNEO : Kuching, Sarawak, in British Museum (Natural History).

Known only from the unique type.

Squamulotilla calliopeia sp. n.

Mutilla calliope Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 85, ♂ (not ♀).

The type specimens of *calliope* Smith in the Saunders' collection, Oxford University, have been examined. The female and male specimens which Smith described as the two sexes of *calliope* are not congeneric. The female specimen, the lectotype, is a specimen of the genus *Smicromyrme* and retains the name *calliope* given by Smith since the first and major portion of the description refers to it. The male is a representative of the genus *Squamulotilla.* Just how the two specimens came to be described as the two sexes of the same species is obscure, but there can be no question that the two specimens are examples of two species belonging to different genera.

The characters used in the key to the males of *Squamulotilla* as criteria for the position of *calliopeia* therein were ascertained during the examination of the male cotype of *calliope* in the Saunders' collection. An opportunity was not available for redescribing Smith's cotype, but the original description of the male was verified with the exception that the legs instead of being entirely black have the coxae pale ferruginous like the thorax.

Holotype.—♂, BORNEO : Sarawak [stands in Saunders' coll., Hope Dept. Oxford University, as cotype of *calliope*, Smith].

Paratypes.—Three ♂♂, BORNEO : Sandakan (*Baker*).

Squamulotilla teuta subsp. *teuta* Mickel.

Squamulotilla teuta subsp. *teuta* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 126, pl. 1, fig. 2, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Los Banos, Luzon (*Baker*), in United States National Museum

Distribution.—PHILIPPINE ISLANDS : Los Banos and Mt. Makiling, Luzon.

Squamulotilla teuta subsp. *vicinaria* Mickel.

Squamulotilla teuta subsp. *vicinaria* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 128, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Cuernos Mts., Negros (*Baker*), in United States National Museum.

Known only from the type locality.

Squamulotilla clypealis sp. n., fig. 1.

♂. Head black, except the mandibles and clypeus tinged with ferruginous; thorax entirely ferruginous; abdomen black, clothed with sparse, erect, pale pubescence; coxae and trochanters ferruginous, remainder of legs black; anterior margin of clypeus broadly, deeply emarginate; hypopygium with only a very feeble, arcuate, transverse carina near the proximal margin; wings with two cubital cells, only cell R_4 absent. Length, 7·5 mm. *Head* black, except the mandibles and clypeus tinged with ferruginous, clothed throughout with more or less intermixed pale fuscous, and pale glittering, sparse pubescence; mandibles slender, acute at the apex and with two small teeth within near the apex; clypeus more or less flattened, the anterior margin broadly and deeply emarginate, appearing distinctly bidentate; scape not carinate beneath, with very small, dense punctures and sparse, pale pubescence; first segment of flagellum only very slightly shorter than the second; antennal scrobes carinate above; front with small, sparse punctures, the vertex and genae with moderate, close punctures; relative widths of head and thorax at the tegulae, 2·7–2·9. *Thorax* entirely ferruginous, clothed with sparse, pale glittering pubescence, except the mesonotum with sparse, pale fuscous pubescence; lateral margins of pronotum slightly sinuate, the humeral angles distinctly angulate; pronotum with moderate, close, indistinct punctures; mesonotum and scutellum with moderate, close, somewhat confluent punctures; parapsidal furrows present; dorsum, posterior face and sides of propodeum all moderately reticulate and rounded into one another, the dorsum without a distinct enclosed space; propleurae defined anteriorly by a carina, sparsely micropunctate; mesopleurae elevated ventrally and dorsally, the two elevated areas separated by a deep furrow, and with moderate, close, indistinct punctures; metapleurae glabrous, impunctate; tegulae small, convex, very indistinctly punctured, and clothed with sparse, pale fuscous pubescence.

Abdomen black, except the first segment tinged with ferruginous anteriorly and beneath, clothed with sparse, pale pubescence; first tergite with very small, scattered punctures; second tergite with small punctures, the distance between the latter from one to two times their diameter, sparsest medio-posteriorly; tergites three to six with small, close, distinct punctures; pygidial tergite with small, close, distinct punctures except a subtriangular, median, apical area almost impunctate; first sternite with a distinct, median, longitudinal carina; proximal third of second sternite with a median, longitudinal carina, the sternite throughout with moderately small, sparse punctures; sternites three to six with moderately, small, somewhat close, distinct punctures; hypopygium with a very feeble, arcuate, transverse carina near the anterior margin and with an elongate, median, apical, obscure fovea. *Wings* subfuscous; cell 2nd $R_1 + R_2$ large, subtriangular, acute at the apex, the latter reaching the margin of the wing; cell R_5 present, receiving vein M_{3+4} slightly beyond the middle; cell R_4 absent. *Legs* blackish, except the coxae and trochanters ferruginous, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Bettotan, near Sandakan, August 21, 1927 (*C. B. K.* and *H. M. P.*), in University of Minnesota collection.

Very easily recognised by the bidentate clypeus, and the apparently simple, flat hypopygium.

Squamulotilla eminula Mickel.

Squamulotilla eminula Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 128, ♂.

Holotype.—♂, Philippine Islands: Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands: Mt. Makiling and Los Banos, Luzon.

Squamulotilla umbrosa Mickel.

Squamulotilla umbrosa Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 130, ♂.

Holotype.—♂, Philippine Islands: Mt. Banahao, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands: Mt. Banahao and Mt. Makiling, Luzon.

Squamulotilla byblis Mickel.

Squamulotilla byblis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 101, ♀.

Holotype.—♀, Philippine Islands: Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands: Mt. Makiling, Mt. Banahao and Los Banos, Luzon; and Sibuyan Island.

Squamulotilla subtriangularis Mickel.

Squamulotilla subtriangularis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 104, ♀.

Holotype.—♀, Philippine Islands: Iligan, Mindanao (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Squamulotilla venatrix sp. n.

♀. Head and abdomen black, except the integument beneath apical pubescent spot of first tergite and apical pubescent band of second tergite, whitish, and the last segment tinged with ferruginous terminally; thorax and legs entirely ferruginous; lateral margins of mesonotum slightly tuberculate; dorsum of thorax distinctly, longitudinally striato-punctate; sides of propodeum with small, distinct, somewhat close punctures; posterior face of propodeum with scattered, indistinct punctures; third to fifth tergites not maculated with pale pubescence; first sternite without a distinct, longitudinal, median carina; hind tibiae not produced externally at the apex, the tibial spine not at the tip of a cylindrical process. Length, 7·5 mm. *Head* black, except the mandibles, clypeus, antennal tubercles, scape, and flagellum beneath, ferruginous; mandibles moderately slender, acute at the apex and with two small teeth within near the apex; median, triangular area of clypeus elevated, indistinctly punctate and pubescent, the outer, anterior angles of the triangle produced, each forming a distinct, acute tubercle; antennal tubercles glabrous; scape not carinate beneath, with small, indistinct punctures and sparse, pale pubescence; first segment of flagellum about twice the length of the second; antennal scrobes distinctly carinate above; front, vertex and genae with moderate, dense, confluent punctures, the front and vertex with sparse, erect, fuscous pubescence, the genae with sparse, pale pubescence; posterior margin of genae defined by an obscure carina; relative widths of head and thorax, 3·5–3·3. *Thorax* entirely ferruginous, distinctly longer than broad, the dorsum with sparse, erect, ferruginous pubescence, the posterior face of propodeum with sparse, long, erect, pale pubescence, the pleural areas with pale micropubescence; dorsum of thorax distinctly, longitudinally striato-punctate, the punctures smaller and denser near the lateral margins of the mesonotum, and with a distinct, median, longitudinal carina; humeral angles distinctly but not prominently angulate; lateral margins of pronotum with a prominent, median, angulate tubercle; lateral margins of mesonotum crenulate; dorsum and posterior face of propodeum separated by a transverse, serrated carina, the latter not extending to the lateral margins of the propodeum, and medially with a prominent, broad, triangular, tooth; lateral margins of dorsum and posterior face of propodeum strongly dentate; the latter with scattered punctures; pro-, meso-, and metapleurae shining, micropunctate and micropubescent; mesopleural process moderately developed, the distal margin straight, truncate; sides of propodeum with small, distinct, somewhat close punctures. *Abdomen* black, except the first sternite ferruginous, the integument beneath the pale pubescent spot of first tergite and the pale pubescent band of second tergite, whitish, and the last segment tinged with ferruginous terminally; first tergite with small punctures, sparse on the anterior face, close on the dorsal face, clothed with sparse, pale pubescence, except an apical, median, transverse spot of thick, pale pubescence; second tergite with moderate, dense punctures becoming less dense laterally, clothed with sparse, erect and recumbent, black pubescence except a broad, apical band, dilated medially, of thick, erect and appressed, pale, glittering pubescence, and broad, lateral margins with sparse, pale pubescence; tergites three to five punctate, the punctures grading from moderately small and sparse anteriorly on each tergite to small and close posteriorly, each clothed with sparse, pale fuscous pubescence; last tergite with moderately small, separated punctures anteriorly and medially, and similar, close punctures laterally, the pygidial area elongate, twice as long as broad, ovate, not defined laterally by carinae, glabrous, unsculptured; last tergite clothed with sparse, pale pubescence; first sternite without a distinct, median, longitudinal carina; second sternite with a pair of subcircular, slightly depressed areas on the anterior half, with moderate, sparse punctures, except the posterior margin with small, close punctures, and sparse, pale pubescence; sternites three to five and hypopygium with moderately small, close punctures and sparse, pale pubescence. *Legs* entirely ferruginous, clothed with sparse, pale pubescence; posterior tibiae not produced externally at the apex, the tibial spine not at the tip of a cylindrical process; calcaria pale.

Holotype.—♀, BORNEO: Sandakan (*Baker*), Cat. no. 50035, United States National Museum.

Related to *galatea* Mickel from the Philippine Islands but differs in having the prominent, triangular tooth on the dorsum of propodeum, the immaculate third to fifth tergites, the entirely ferruginous legs, and the punctate sides of propodeum.

Squamulotilla cardea sp. n.

♀. Head and abdomen black, except the mandibles, clypeus and scape largely ferruginous, the integument beneath the pale pubescent spot of first tergite and pale pubescent band of second tergite, whitish, and the last segment tinged with ferruginous; thorax and legs entirely ferruginous; junction of dorsum and posterior faces of propodeum defined by a transverse, serrate line, the latter with a prominent, median, slender tooth; dorsum of thorax distinctly, longitudinally striato-punctate; lateral margins of pronotum not dentate nor tuberculate, except the humeral angles conspicuously acute; distal external spine of hind tibiae at the tip of a short, cylindrical process; tergites three to five immaculate. Length, 7·5 mm. *Head* black, except the mandibles, clypeus and scape, ferruginous; flagellum beneath tinged with ferruginous; mandibles moderately slender, acute at the apex and with two small teeth within near the apex; median triangular area of clypeus elevated, indistinctly punctate and pubescent, the outer, anterior angles of the triangle produced, each forming a distinct, acute tubercle; antennal tubercles glabrous; scape not carinate beneath, finely punctate and with sparse, pale pubescence; first segment of flagellum about twice the length of the second; antennal scrobes carinate above; front, vertex and genae with moderate punctures, close and confluent on the front, dense on the vertex and genae, the front and vertex with sparse, fuscous pubescence, the genae with sparse, pale pubescence; genae defined posteriorly by a distinct but not prominent carina; relative widths of head and thorax at the pronotum, 3·2–2·8. *Thorax* entirely ferruginous, distinctly longer than broad, the dorsum with sparse, ferruginous pubescence, posterior face of propodeum with sparse, long, pale pubescence, the pleural areas pale micropubescent; dorsum of thorax narrower anteriorly than posteriorly, relative widths at pronotum and dorsum of propodeum, 2·8–3·3, distinctly, longitudinally striato-punctate, the punctures smaller and dense on the lateral areas of mesonotum; humeral angles conspicuously acute; lateral margins of pronotum sinuate but not tuberculate nor dentate; lateral margins of mesonotum sinuate, slightly diverging; junction of dorsum and posterior face of propodeum defined by a transverse, serrate line, the latter with a prominent, median, slender tooth; lateral margins of dorsum and posterior face of propodeum strongly dentate; posterior face of propodeum with scattered punctures; pro-, meso-, and metapleurae shining, micropunctate and micropubescent; mesopleural process not strongly developed, more or less inconspicuous, the distal margin straight, truncate; sides of propodeum shining, with small, sparse punctures. *Abdomen* black, except the first sternite ferruginous, the integument beneath the pale pubescent spot of first tergite and pale pubescent band of second tergite, whitish, and the last segment tinged with ferruginous; first tergite with small punctures, sparse on the anterior face, close on the dorsal face, clothed with sparse, pale pubescence, except the dorsal face with a large, apical, median, transverse spot of appressed, pale pubescence; second tergite with small, dense punctures, the latter less dense laterally, clothed with sparse, black pubescence, except laterally with sparse, pale pubescence, and the apical margin with a broad band of appressed, pale pubescence wider medially than laterally; tergites three to five with small, close punctures, clothed with sparse, pale fuscous pubescence; pygidial area elongate, ovate, about twice as long as broad, not defined laterally by carinae, glabrous and impunctate; elsewhere the last tergite with small, close punctures and sparse, pale pubescence; first sternite without a distinct, median, longitudinal carina; second sternite with a short, median, longitudinal carina on the anterior fourth, with moderate, sparse punctures except the apical margin with small, close punctures, clothed throughout with sparse, pale pubescence; sternites three to five, and the hypopygium with moderately small, close punctures and sparse, pale pubescence. *Legs* entirely ferruginous, clothed with sparse, pale pubescence; external, apical, tibial spine at the tip of a short cylindrical process; calcaria pale.

Holotype.—♀, Borneo: Bettotan, near Sandakan, July 25, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratypes.—♀, Borneo: Bettotan, near Sandakan, August 13, 1927 (*C. B. K.* and *H. M. P.*); ♀, W. Borneo: Mowong, September, 1907 (*F. Muir*).

Related to *galatea* and *venatrix*. The form of the thorax and the distal spur of the posterior tibiae characterise this species.

Squamulotilla galatea Mickel.

Squamulotilla galatea Mickel, 1934, *Philipp. J. Sci.*, **54** (1): 106, ♀.

Holotype.—♀, Philippine Islands: Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands: Luzon.

Squamulotilla saffica (Zavattari).

Odontomutilla saffica Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 68, ♀.

Cotypes.—Two ♀♀, Celebes: Minahassa and Pangie, in Museo Civico di Storia Naturale, Genoa.

Specimens examined.—♀, Celebes: Menado, May 6, 1905 (*R. Shelford*).

Distribution.—Celebes.

Squamulotilla opipara (Zavattari).

Mutilla opipara Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 81, ♀.

Holotype.—♀, Federated Malay States: Perak, in Museo Civico di Storia Naturale, Genoa.

Distribution.—Known only from the type locality.

Squamulotilla malica (Zavattari).

Mutilla malica Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 83, ♀.

Holotype.—♀, Federated Malay States: Perak, in Museo Civico di Storia Naturale, Genoa.

Distribution.—Known only from the type locality.

Squamulotilla multidentata (André).

Mutilla multidentata André, 1896, *Ann. Mus. civ. Genova*, (2) **17**: 75, ♀.
Odontomutilla multidentata André, 1903, *Gen. Insect.*, **11**: 29, ♀.
Odontomutilla multidentata Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 68, ♀.

Holotype.—♀, Sumatra: Si-Rambé (*E. Modigliani*), in Museo Civico di Storia Naturale, Genoa.

Zavattari (1913) records this species from the island of Simalu off the west coast of Sumatra. André mentions a second specimen (without a head) from Perak. I have seen only the unique type.

Squamulotilla deserta (Smith).

Mutilla deserta Smith, 1879, *Descr. New Sp. Hymen.*: 200, ♀.
Mutilla deserta Dalle Torre, 1897, *Cat. Hymen.*, **8**: 30, ♀.
Mutilla deserta André, 1903, *Gen. Insect.*, **11**: 39, ♀.
Squamulotilla deserta Mickel, 1934, *Philipp. J. Sci.*, **54** (1): 109, ♀.

Holotype.—♀, Celebes, in British Museum (Natural History).

Distribution.—Celebes and Philippine Islands: Luzon.

Squamulotilla aesyca (Cameron).

Mutilla aesyca Cameron, 1902, *Entomologist*, **35** : 208, ♀.

Holotype.—♀, Borneo, in British Museum (Natural History).

Specimens examined.—♀, Borneo : Pontlanak (*F. Muir*); ♀, Kuching, August 14, 1899 (*Dyak*); ♀, British N. Borneo : Mt. Kinabula, May 3, 1929 (*H. M. Pendlebury*).

Two of the specimens listed above have been compared with Cameron's type and found to be the same. The specimen from British North Borneo has the head more extensively black, with only a ferruginous spot on the median, anterior portion of the vertex.

Squamulotilla ardescens (Smith).

Mutilla ardescens Smith, 1873, *Trans. ent. Soc. Lond.*, **1873** : 182, no. 3, ♀.
Mutilla pungens Smith, 1873, *Trans. ent. Soc. Lond.*, **1873** : 182, no. 4, ♀.
Mutilla pungens Smith, 1874, *Trans. ent. Soc. Lond.*, **1874** : 407, ♀.
Mutilla ardescens Dalle Torre, 1897, *Cat. Hymen.*, **8** : 10, ♀.
Mutilla militans Dalle Torre, 1897, *Cat. Hymen.*, **8** : 62, ♀.
Mutilla pungens Dalle Torre, 1897, *Cat. Hymen.*, **8** : 75, ♀.
Mutilla ardescens André, 1903, *Gen. Insect.*, **11** : 70, ♀.
Mutilla pungens André, 1903, *Gen. Insect.*, **11** : 71, ♀.
Mutilla pungens Matsumura, 1931, 6000 *Illust. Ins. Japan Empire* : 29, ♀.
Mutilla pungens Esaki et alii, 1932, *Icon. Insect. Jap.* : 326, ♀.
Mutilla pungens Matsumura, 1932, *Illust. Common Ins. Japan*, **4** : 8 (Japanese text) : 11 (English text), pl. 2, fig. 21, ♀.

Holotype of *ardescens*.—Lost.

Holotype of *pungens*.—♀, Hiogo, Japan, in British Museum (Natural History).

Specimens examined.—♀, Hiogo, Japan (74–16).

The two papers by F. Smith (1873, 1874) describing species of Mutillidae from Japan have proved very confusing on account of the repetition of specific names, the similarity in the descriptions bearing the same names, and the absence of type material for the species described in the 1873 paper. I have examined carefully all the Mutillid material in the British Museum (Natural History) and found no trace of any material which can definitely be said to be the basis for the 1873 paper. On the other hand type specimens are present for all the species mentioned in the 1874 paper. In addition to the absence of type material for the 1873 species, the following facts seem to be pertinent. In the first paper (1873) the descriptions of the Mutillidae are at the beginning of a series dealing with the aculeate Hymenoptera; in the second paper the Mutillid descriptions are at the end of a series dealing with non-aculeate Hymenoptera; if the descriptions of species with the same name in the two papers are compared it is found that they are so similar as to have been made at different times from the same specimen. A consideration of these facts leads me to the opinion that the descriptions of the Mutillidae were drawn up by Smith at odd times; that on account of some reason unknown the specimens were not labelled at the time the first descriptions were made; that as a result of this one species was described twice in the first paper, once under the name of *ardescens* and once under the name of *pungens*; that the individual descriptions were assembled and published in the first paper; that later this was overlooked, the specimens again described and the descriptions placed at the end of the second paper on the Japanese Hymenoptera.

If one compares carefully the descriptions of *ardescens* and *pungens* (1873) and *pungens* (1874), there can be no doubt that all three descriptions are of the same species, and possibly of the same specimen. Dalle Torre's name *militans* proposed to replace *pungens* (1874) also falls as a synonym under these conditions.

The specimen examined is one found unnamed in the collections of the British Museum (Natural History). It was compared with the specimen labelled by Smith as *pungens* and found to be identical.

Squamulotilla oblectabilis Mickel.

Squamulotilla oblectabilis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 109, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : Luzon.

Squamulotilla sauteri (Zavattari).

Mutilla sauteri Zavattari, 1913, *Arch. f. Naturges.*, **79A** (3) : 27, ♀.
Squamulotilla sauteri Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 386, ♀.

Lectotype.—♀, FORMOSA : Taihorin, 1911 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from the type locality.

Squamulotilla trituberculata Mickel.

Mutilla sauteri Zavattari, 1913, *Arch. f. Naturges.*, **79A** (3) : 27, ♀ (in part).
Squamulotilla trituberculata Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 386, ♀.

Holotype.—♀, FORMOSA : Hoozan, March 10 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from the type locality.

Squamulotilla fucosa Mickel.

Squamulotilla fucosa Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 111, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Surigao, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : Mindanao.

Squamulotilla erdae (Zavattari).

Mutilla erdae Zavattari, 1913, *Arch. f. Naturges.*, **79A** (3) : 26, ♀.
Squamulotilla erdae Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 386, ♀.

Lectotype.—♀, FORMOSA : Hoozan, January, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—FORMOSA.

Squamulotilla carinulifera (André).

Mutilla carinulifera André, 1908, *Ann. Mus. nat. Hung.*, **6** : 377, ♀.
Mutilla carinulifera Zavattari, 1913, *Arch. f. Naturges.*, **79A** (3) : 27, ♀.
Squamulotilla carinulifera Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 386, ♀.

Holotype.—♀, FORMOSA : Takao, in Hungarian National Museum, Budapest.

Distribution.—Known only from the unique type.

Squamulotilla arundinacea Pagden.

Squamulotilla arundinacea Pagden, 1934, *J. F.M.S. Mus.*, **17** : 445, figs. 15 and 16, ♀.

Holotype.—♀, FEDERATED MALAY STATES : Parit Buntar, Perak, November 27, 1931, in British Museum (Natural History).
Distribution.—FEDERATED MALAY STATES.

Squamulotilla perakensis Pagden.

Squamulotilla perakensis Pagden, 1934, *J. F.M.S. Mus.*, **17** : 448, figs. 17–19, ♀.

Holotype.—♀, FEDERATED MALAY STATES : Parit Buntar, Perak, June 22, 1929, in British Museum (Natural History).
Distribution.—FEDERATED MALAY STATES.

Squamulotilla selangorensis Pagden.

Squamulotilla selangorensis Pagden, 1934, *J. F.M.S. Mus.*, **17** : 452, fig. 20, ♀.

Holotype.—♀, FEDERATED MALAY STATES : Bukit Kutu, Selangor, January 31, 1930, in British Museum (Natural History).
Distribution.—FEDERATED MALAY STATES.

Cystomutilla André.

The following species is assigned to *Cystomutilla* somewhat doubtfully. I have not had an opportunity to examine the type species of this genus, but have compared the specimens with André's diagnosis of the genus and with the published descriptions of *Cystomutilla ruficeps.* This Japanese species agrees better with *Cystomutilla* than any other described genus. The thorax is elongate and the eyes almost exactly circular, both of which characters eliminate the species from *Dasylabroides.* In addition the latter is an African genus while this Japanese species comes from the island of Hokkaido which lies north of the fortieth parallel. I have seen no other species similar to this from any of the Pacific Islands or from China.

Cystomutilla (?) **teranishii** sp. n.

♀. Head and abdomen, black, thorax entirely ferruginous, legs ferruginous, except the femora and tibiae more or less infuscated; first and second abdominal tergites with an apical fringe of pale pubescence, that on the first very thin, that on the second thick, the third segment clothed with sparse, recumbent, pale pubescence; eyes small, circular, moderately convex; thorax elongate, narrowed posteriorly; scutellar scale absent; first abdominal segment sessile with the second; pygidial area distinct, margined laterally, glabrous, impunctate throughout. Length, 6·5 mm. *Head* entirely black, except the mandibles medially and the antennal tubercles, obscurely ferruginous; the front and vertex clothed with sparse, erect, black pubescence, the genae with sparse, erect pale pubescence; mandibles moderately robust, edentate at the tip and with a distinct tooth within very close to the apex, thus appearing bidentate, not at all excised beneath; clypeus elevated into a transverse, inconspicuous ridge posteriorly, the elevated margin of the ridge obscurely crenulate; antennal tubercles subspherical, small, slightly separated; scape with small, close punctures beneath; first segment of flagellum almost equal in length to the second, very slightly shorter; antennal scrobes not distinctly carinate above; front, vertex and genae with moderate, dense, only slightly confluent punctures; eyes small, circular, moderately convex, the malar space less than the distance between the eye-margins and the postero-lateral angles, the latter equal to one and one-third times the diameter of the eyes; relative widths of head and thorax, 2·2–2·1. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, black pubescence, the posterior face of propodeum with sparse, erect, pale pubescence, and the pleural areas with sparse, appressed, pale pubescence; thorax pyriform, the propodeum narrower than the pronotum and mesonotum, relative widths at humeral angles, anterior spiracles, propodeal spiracles and posterior region of propodeum, 2·0–2·1–1·7–1·2; dorsum of thorax with moderate, dense, confluent punctures; humeral angles distinctly angulate; lateral margins of pronotum slightly concave; lateral margins of mesonotum converging posteriorly; scutellar scale entirely absent; propodeal spiracles prominently tuberculate; propleurae with small, close, shallow punctures; mesopleurae with a narrow, postmedian, moderately punctate area extending from ventral to dorsal margins, elsewhere micropunctate; metapleurae glabrous, micropunctate; sides of propodeum glabrous, micropunctate, with sparse, small, shallow punctures. *Abdomen* entirely black, the first segment sessile with the second; first and second tergites with apical fringes as mentioned above, the third clothed with sparse, recumbent, pale pubescence; first tergite with sparse, erect, pale pubescence anteriorly and laterally; first and second tergites elsewhere, and fourth and fifth tergites entirely clothed with sparse, recumbent, black pubescence; all the sternites clothed with sparse, pale pubescence; first and second tergites with sparse, moderately small punctures; tergites three to five with fine, separated punctures; pygidial area elongate, the sides very slightly converging posteriorly, glabrous, impunctate throughout, defined laterally by a carina; first sternite with a median, longitudinal carina on the anterior half, distinct at the anterior margin, indistinct posteriorly; second sternite with sparse, small punctures; sternites three to five and the hypopygium finely punctate posteriorly. *Legs* ferruginous, all the femora and tibiae infuscated on the distal half, clothed with sparse, erect, pale pubescence; external surface of middle and posterior tibiae with a single row of spines; posterior coxae separated by a narrow, tongue-like process of the mesosternum; calcaria ferruginous.

Holotype.—♀, JAPAN: Jozankei, Hokkaido, August 4, 1922 (*C. Teranishi*), in University of Minnesota collection.

Paratypes.—♀, JAPAN: Sapporo, Hokkaido, July 9, 1922 (*C. Teranishi*); ♀, Koiwai fm, August 20, 1922 (*C. Teranishi*).

Rhopalomutilla André.

Rhopalomutilla oceanica sp. n.

♂. Black, except the mandibles, scape, pedicel, tegulae, middle and posterior trochanters and femora, ferruginous, clothed throughout with sparse, pale pubescence; mandibles tridentate; anterior margin of clypeus tuberculate; pygidial tergite with an elongate, median, subgibbose, glabrous, impunctate area on the basal half; wings subhyaline; cell R_4 almost obsolete. Length, 8 mm. *Head* black, except the mandibles, scape and pedicel, ferruginous, clothed with sparse, erect, pale glittering pubescence, thicker on the clypeus and the anterior portion of front; mandibles moderately broad, acute at the apex, and with two small teeth within near the apex; anterior margin of clypeus with two pairs of small tubercles, the outer pair somewhat larger than the inner pair; median area of clypeus with a fifth, submarginal, median tubercle; clypeus finely and densely punctate throughout; antennal tubercles widely separated, the distance between the antennae at least twice the distance between an antenna and eye; scape not carinate beneath, with fine, dense punctures; first segment of flagellum slightly but distinctly shorter than the second; antennal scrobes not carinate above; front, vertex and genae with large, shallow punctures, the anterior half of front also with fine, dense punctures; relative widths of head and thorax at the tegulae, 3·2–3·3. *Thorax* entirely black, clothed with sparse, erect, pale glittering pubescence, thickest on the mesopleurae; pronotum with large, shallow, close punctures; humeral angles rounded; mesonotum and scutellum with large, shallow, close punctures, the scutellum evenly convex; dorsum and posterior face of propodeum rounded into one another, shallowly reticulate, except the median enclosed space; the latter large, its width equal to one-third the width of propodeum, extending posteriorly on to the posterior face, the lateral margins converging posteriorly and defined by a raised line, the latter obsolete posteriorly; anterior margin of propleurae not distinctly defined by a carina, indistinctly punctate; anterior third of mesopleurae glabrous, almost impunctate, the remaining two-thirds with large, shallow, close punctures; metapleurae and sides of propodeum glabrous, micropunctate; tegulae ferruginous, small, the posterior margin slightly reflexed, glabrous, with a few, scattered, pale hairs laterally and anteriorly. *Abdomen* entirely black, clothed throughout with sparse, erect, pale pubescence, and each segment fringed apically above and below with a sparse fringe of stiff, pale hairs; first abdominal segment approximately equal in length to the posterior femora; first tergite with large, shallow, close punctures; second tergite with large, shallow, close punctures anteriorly and medially, the punctures becoming small and close at the posterior margin; tergites three to six with small, very close punctures; last tergite with a median, elongate, subgibbose, glabrous, impunctate area on the anterior half merging into a subtriangular impunctate area on the posterior half, elsewhere with moderately small, dense punctures; first sternite with moderately small, dense punctures, without a median longitudinal carina; second sternite with large, distinct punctures anteriorly, becoming gradually smaller posteriorly, those at the posterior margin small and dense; sternites three to six with very small, close punctures. *Wings* subhyaline; cell 2nd $R_1 + R_2$ slightly longer than R + 1st R_1, acute at the apex; cell R_5 receiving vein M_{3+4} at the middle; cell R_4 almost obsolete, receiving the almost obsolete vein M_2 at the middle. *Legs* black, except the intermediate and posterior trochanters and femora ferruginous; all the legs clothed with sparse, pale pubescence; calcaria pale.

♀. Black, with bronze reflections, except the mandibles, clypeus, antennae, legs, and last abdominal segment, entirely ferruginous, clothed throughout with sparse, short, erect and suberect, pale fuscous, glittering pubescence; antennae subclavate, the last segment of the flagellum as long as segments six to nine united; thorax strongly constricted at the propodeal spiracles, the propodeum much narrower than the mesonotum; lateral margins of dorsum and posterior face of propodeum strongly crenulate; pygidium distinct, densely punctate proximately, faintly granulate distally, sparsely clothed with recumbent pubescence. Length, 4 mm. *Head* black, with obscure, ferruginous bronze reflections, clothed with sparse, short, erect, pale fuscous pubescence, except the mandibles, clypeus and antennae, entirely pale ferruginous; mandibles moderately slender, edentate at the apex and with a small tooth within; anterior margin of clypeus very broadly and shallowly emarginate, and with a median, posterior spine-like tubercle between the antennae; scape with small, dense punctures; proximal flagellar segments broader than long; front, vertex and genae with moderate, dense, deep, confluent punctures; relative widths of head and thorax, 1·7–1·6. *Thorax* entirely black, with obscure, ferruginous bronze reflections, clothed with sparse, short, erect, pale fuscous pubescence; dorsum with moderately large (somewhat coarser than on the head) dense, deep, confluent punctures; pronotum distinctly narrowed anteriorly; humeral angles slightly tuberculate; pronotum and mesonotum each with a pair of distinct tubercles at the postero-lateral angles, those on the mesonotum the more conspicuous; propodeum distinctly narrower than the mesonotum, the lateral margins of the dorsum and posterior face strongly crenulate; distal half of posterior face of propodeum with small, close punctures; propleurae and mesopleurae with moderate, dense, deep punctures; metapleurae and sides of propodeum with small, close, distinct punctures; scutellar scale entirely absent. *Abdomen* black with conspicuous, ferruginous bronze reflections, except the last segment entirely ferruginous, clothed with erect and suberect, pale fuscous, glittering pubescence; first tergite with moderate, dense, deep, confluent punctures; second tergite with short, longitudinal striae in the anterior, submarginal depression, elsewhere with moderately small, close, more or less confluent punctures, less coarsely punctured than the first tergite; tergites three to five with very small, dense punctures; last tergite, except the pygidial area with small, dense, deep punctures; pygidial area well defined, the proximal half with small, dense punctures, the distal half faintly granulate, clothed with sparse, recumbent pubescence; first sternite with small, dense punctures; second sternite with moderately small, close, distinct punctures; sternites three to five with small, dense punctures. *Legs* entirely ferruginous, closely punctate, clothed with sparse, pale, glittering pubescence; calcaria pale ferruginous.

Holotype.—♂, NORTH BORNEO: Bettotan, near Sandakan, August 10, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Allotype.—♀, NORTH BORNEO: Bettotan, near Sandakan, August 10, 1927 (*C. B. K.* and *H. M. P.*); mounted on same pin as holotype.

Paratypes.—♂, NORTH BORNEO: Samawang, near Sandakan, July 9, 1927 (*C. B. K.* and *H. M. P.*); three ♂♂, BORNEO: Sandakan (*Baker*).

This is the only species of the genus known from the Islands of the Pacific.

Mutilla L.

Mutilla europaea subsp. *mikado* Cameron.

Mutilla mikado Cameron, 1900, *Mem. Manchester lit. phil. Soc.*, **44** (15) : 75, ♀.
Mutilla europaea André, 1901, *Spec. Hymen. Eur. Alger.*, **8** : 240, ♀ (Japan record only).
Mutilla mikado André, 1903, *Gen. Insect.*, **11** : 40, ♀.
Mutilla mikado Esaki et alii, 1932, *Icon. Insect. Jap.* : 325, ♀.

Holotype.—♀, JAPAN, in British Museum (Natural History).

Specimens examined.—♀, JAPAN: Tokio (81–37).

I have examined Cameron's type and compared it with specimens of *Mutilla europaea* from Europe. The Japanese specimens are almost identical with European ones, except for subtle differences in puncturation. The most obvious sculptural difference is that in *europaea* from Europe the sides of the propodeum have scattered small punctures, while the Japanese specimens have moderate, close, shallow punctures on the same area. André (1901) records *europaea* from Japan, basing the statement on specimens from Japan which I find are identical with *mikado* Cameron. I regard the Japanese specimens as a subspecies of *europaea* L.

Odontomutilla Ashmead.

Key to the Species.

♂♂.

1. Postero-lateral angles of dorsum evenly rounded, not at all produced . . 2.
Postero-lateral angles of dorsum of propodeum produced, prominently angulate . . . . 5.
2. Second tergite with moderate, distinct punctures throughout the discal area; femora entirely ferruginous or not . . . . 3.
Second tergite with the discal area glabrous, sparsely punctate; coxae, trochanters and femora entirely ferruginous, the tibiae and tarsi, black *pedaria* Mickel.
3. At least the distal half of femora black; wings either entirely fuscous or only the distal half subfuscous . . . . 4.
Coxae, trochanters and femora entirely ferruginous; wings subhyaline with a slightly darker cloud in cells R + 1st R_1, 2nd $R_1 + R_2$, and R_5 *cassiope* (Smith).

4. Legs entirely black; wings uniformly subfuscous; pale pubescent band of third tergite entire . . . . *taiwaniana* (Zavattari).

Coxae, trochanters and proximal fourth of femora, ferruginous, the remainder of legs black; proximal half of wings hyaline, the apical half subfuscous, cells R + 1st R_1 and 2nd $R_1 + R_2$ with a darker cloud *andromeda* Mickel.

5. Abdominal tergites entirely black pubescent . . . . *manifesta* (Smith).

Third abdominal tergite maculated with dense, appressed, pale pubescence 6.

6. Second abdominal sternite with a prominent, median, slightly bifurcate tubercle . . . . *apiastra* nom. n.

Second abdominal sternite simple, not at all tuberculate medially . . . 7.

7. Third abdominal tergite with a band of dense, appressed, pale pubescence, interrupted medially, usually distinctly and broadly so, rarely only subinterrupted . . . . 8.

Third abdominal tergite with a broad band of dense, appressed, pale pubescence, slightly narrowed medially, but not interrupted . . . 11.

8. Thorax entirely, or almost entirely ferruginous, at the most with the sternum black . . . . 9.

Propodeum and pleurae more or less black . . . . 10.

9. Postero-lateral angles of dorsum of propodeum angulate but not prominent; pale pubescent band of third tergite narrow, its width about half the length of the tergite, very broadly interrupted medially . . . . *inanis* sp. n.

Postero-lateral angles of dorsum of propodeum prominent, subacute; pale pubescent band of third tergite broad, its width almost the length of the tergite, narrowly interrupted medially . . . . . . *ceramensis* sp. n.

10. Postero-lateral angles of propodeum distinctly angulate, the process low and the angle at the tip of the process not less than a right angle; pubescence of tegulae black . . . . *semifasciata* (André).

Postero-lateral angles of propodeum strongly produced, subspinose, the angle at the tip of the process acute; pubescence of tegulae fulvous *familiaris familiaris* (Smith).

11. Thorax entirely ferruginous . . . . . . *simplicifascia* (Sich. & Rad.).

Propodeum and basal half of mesopleurae black . . . . 12.

12. Head entirely black . . . . *herpa* (Cameron).

Head entirely ferruginous . . . . 13.

13. Anterior margin of hypopygium with a median tubercle, the latter directed slightly caudad; median lateral fourths of second tergite with moderate, close, confluent punctures . . . . *rubrocapitata* sp. n.

Anterior margin of hypopygium without a median tubercle; median lateral fourths of second tergite with large, coarse punctures . . . . . 14.

14. Median lateral fourths of second tergite with coarse, close, confluent punctures . . . . *haematocephala* (André).

Median lateral fourths of second tergite with coarse, separate punctures *aspratilis* sp. n.

♀♀.

1. Second tergite with a large, antero-lateral pubescent fovea . . . . 5.

Second tergite without any such fovea . . . . 2.

2. Second abdominal tergite for the most part with moderate to large, confluent punctures; scape either pale or dark ferruginous . . . . . 3.

Second abdominal tergite entirely with small to fine, more or less confluent punctures; scape black; coxae, trochanters and proximal part of femora, pale ferruginous . . . . *andromeda* Mickel.

3. Basal two-thirds of second tergite with moderate, confluent punctures; at least the scape, coxae, trochanters and femora, pale ferruginous . . 4.

Basal two-thirds of second tergite with large, confluent punctures; scape and legs dark ferruginous, infuscated with black . *taiwaniana* (Zavattari).

4. Coxae, trochanters and femora, pale ferruginous, the tibiae and tarsi black *cassiope* (Smith).

Legs entirely pale ferruginous . . . . *pedaria* Mickel.

5. Head entirely ferruginous . . . . 6.

Head entirely black . . . . 9.

6. Pubescent fovea of second tergite elongate, somewhat more than three times as long as broad . . . . 7.

Pubescent fovea of second tergite short, only two and one-half times as long as broad . . . . *thymele* sp. n.

7. Lateral margins of mesonotum with a distinct, blunt tooth just posterior to the anterior spiracle; dorsum of thorax coarsely, longitudinally rugose 8.

Lateral margins of mesonotum slightly angulate just posterior to the anterior spiracle; dorsum of thorax coarsely, densely punctate but not longitudinally rugose . . . . *pompalis* sp. n.

8. Mesonotal tooth very large and prominent, its length equal to one-tenth the greatest width of the thorax; dorsum of thorax exceedingly coarsely and deeply sculptured; length, 18 mm. . . . . *grossa* sp. n.

Mesonotal tooth only moderately developed, its length equal to only one-sixteenth the greatest width of the thorax; dorsum of thorax moderately, coarsely sculptured; length, 14 mm. . . . . *urania* (Smith).

9. Second tergite with a median, basal spot; third tergite with a broad band of dense, appressed, silvery pubescence . . . . 12.

At least the second tergite without a median, pale pubescent spot . . . 10.

10. Abdominal tergites entirely black pubescent . . . . . *manifesta* (Smith).

Third abdominal tergite with a broad band of dense, appressed, pale pubescence . . . . 11.

11. Pubescent band of third tergite complete . . *simplicifascia* (Sich. & Rad.).

Pubescent band of third tergite interrupted medially with black *inanis* sp. n.

12. Propodeum and ventral areas of meso- and metapleurae entirely black *tamensis* (Cameron).

Thorax entirely ferruginous . . . . 13.

13. Posterior face of propodeum finely punctate throughout, the rugae of the dorsum not extending on to the posterior face . . . *unimaculata* (Smith).

Posterior face of propodeum with moderate punctures, the rugae of the dorsum extending on to the anterior fourth of the posterior face . . 14.

14. Apical half of punctate area on tergites 4–5 with small, distinctly separated punctures . . . . 15.

Apical half of punctate area on tergites 4–5 with small, close, almost dense punctures . . . . *smithi* sp. n.

15. Pale pubescent spot of second tergite slightly longer than broad *familiaris familiaris* (Smith).

Pale pubescent spot of second tergite distinctly broader than long *familiaris anonyma* (Kohl).

Odontomutilla familiaris familiaris (Smith).

Mutilla familiaris Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 84, ♀.
Mutilla familiaris Dalle Torre, 1897, *Cat. Hymen.*, **8** : 39, ♀.
——— *familiaris* André, 1903, *Gen. Insect.*, **11** : 70, ♀.
Odontomutilla familiaris Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 132, ♀ and ♂.

Holotype.—♀, MALAY PENINSULA : Singapore, in Saunders' collection, Oxford University.

Allotype.—♂, PHILIPPINE ISLANDS : Dapitan, Mindanao (*Baker*), in United States National Museum.

Specimens examined.—♀, five ♂♂, Borneo: Bettotan near Sandakan, August 6 to 20, 1927 (*C. B. K.* and *H. M. P.*); ♂, Samawang near Sandakan, July 10, 1927 (*C. B. K.* and *H. M. P.*); ♂, Kudat, September 14, 1927 (*C. B. K.* and *H. M. P.*); ten ♀♀, nine ♂♂, Sandakan (*Baker*); ♂, Kuching, September 30, 1897; ♂, Kuching, September 15, 1900 (*Dyak*).

Distribution.—Philippine Islands; Borneo; and Malay Peninsula(?).

I have seen no specimens of this species from the Malay Peninsula. Three of the female specimens from Borneo and one from the Philippine Islands have been compared with Smith's holotype.

Odontomutilla familiaris anonyma (Kohl).

Mutilla anonyma Kohl, 1882, *Verh. zool.-bot. Ges. Wien*, **32** : 482, pl. 32, fig. 20, ♀.
Mutilla anonyma Dalle Torre, 1897, *Cat. Hymen.*, **8** : 9, ♀.
Odontomutilla anonyma André, 1903, *Gen. Insect.*, **11** : 29, ♀.

Holotype.—♀, Sumatra, in Naturhistorisches Staatsmuseum, Vienna.

Distribution.—Known only from the type locality.

I have examined the unique type and find it is only separable from *familiaris* Smith by the character used in the key.

Odontomutilla smithi sp. n.

Mutilla unimaculata Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 75 (*nec unimaculata* Smith, 1858) (♀, *nec* ♂).
?*Odontomutilla unimaculata* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 67, ♀.

♀. Head, abdomen and legs black, the thorax entirely ferruginous; head coarsely punctate; dorsum of thorax coarsely, longitudinally, rugoso-punctate, the rugae extending on to the anterior fourth of the posterior face of propodeum; second abdominal tergite with a median, anterior spot of dense, appressed, pale pubescence, the spot distinctly broader than long; third tergite clothed with dense, appressed, pale pubescence, distinctly interrupted medially with black; second tergite with a large, antero-lateral pubescent fovea. Length, 15 mm. *Head* entirely black, except the mandibles medially and the flagellum beneath, tinged with ferruginous, the front and vertex clothed with sparse, erect, pale fuscous pubescence, the genae with sparse, erect, pale, glittering pubescence; mandibles moderately slender, edentate at the apex, apparently without a tooth within; triangular median area of clypeus elevated and with a pair of large, transverse tubercles posteriorly; scape not carinate beneath, with scattered, moderate, shallow punctures and sparse, pale, glittering pubescence; first segment of flagellum distinctly longer than the second when viewed from below, the second much broader than long; antennal scrobes very strongly carinate above; front, vertex and genae, coarsely, irregularly, rugoso-punctate, the posterior half of front, and the vertex with a distinct median, longitudinal carina; posterior margin of genae defined by a distinct carina; relative widths of head and thorax, 5·6–5·8. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, pale ferruginous pubescence, the propodeum and pleurae clothed with sparse, pale pubescence, that on the propodeum and mesopleurae long; dorsum of thorax very coarsely, longitudinally, rugoso-punctate, the rugae extending on to the anterior fourth of the posterior face of propodeum; humeral angles rounded, not prominent, lateral margins of pro- and mesonotum somewhat crenulate, subparallel; propodeum slightly narrower than mesonotum; relative widths of thorax at humeral angles, anterior spiracles, and just behind propodeal spiracles, 5·3–5·8–5·0; scutellar scale absent; posterior three-fourths of posterior face of propodeum with moderate, close punctures; lateral margins of posterior face of propodeum not crenulate or denticulate; propleurae defined anteriorly by a strong carina; pro- meso- and metapleurae, and sides of propodeum micropunctate and micropubescent, the mesopleurae also with moderate, shallow punctures at the posterior margin, the metapleurae with obscure, moderate punctures postero-ventrally, and the sides of propodeum with obscure, moderate, scattered punctures throughout. *Abdomen* entirely black, clothed with sparse, erect and recumbent, black pubescence, except the anterior face of the first tergite and all the sternites with sparse, erect, pale glittering pubescence, the second tergite with a median, anterior spot broader than long of dense, appressed, pale pubescence, the third tergite clothed entirely with similar pubescence interrupted medially with black, and the second and third sternites with narrow, apical bands of dense, appressed, pale pubescence; anterior face of first tergite with sparse, moderate punctures; dorsal face of first tergite with moderate, dense, confluent punctures; dorsal and anterior faces of first tergite angulately separated; second tergite with a large, deep, elongate fovea at the antero-lateral angles, the fovea almost four times as long as broad; second tergite with moderate, dense, confluent punctures, except the narrow, apical margin glabrous, impunctate, the punctures smaller posteriorly than anteriorly, and the lateral areas of the tergite with sparse, pale pubescence; tergites three to five with moderate, dense, confluent punctures, the latter smaller posteriorly than anteriorly on each tergite, and the apical margin of each tergite glabrous, impunctate; last tergite strongly, closely asperated, except a median, distal, subtriangular area transversely striato-granulate; first sternite without a distinct, longitudinal, median carina; second sternite with large, distinct, somewhat close punctures, closer laterally, closer and smaller posteriorly; sternites three to five, and hypopygium with moderate, close, more or less confluent punctures. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♀, CELEBES: Macassar, in Saunders' collection, Oxford University.

Paratype.—♀, CELEBES: Macassar, mounted on same pin with ♂ *Smicromyrme fredericki*, in Saunders' coll., Hope Dept. Oxford University.

This species differs from *unimaculata* Smith in the sculpture of the posterior face of propodeum, *unimaculata* having that area finely punctate throughout, without rugae anteriorly, and by the less developed pale pubescent bands on the sternites, *unimaculata* having dense, pale, apical, pubescent bands on sternites two, three and four.

The specimen described by Smith as the male of *unimaculata* is mounted on the same pin as the paratype. How the two specimens came to be regarded as the sexes of the same species is unknown. Perhaps Smith inferred that since the two were mounted on the same pin they were taken *in coitu*. This male is *Smicromyrme fredericki* described hereafter. The males of *unimaculata* and *smithi* are still unknown, although the latter may prove to be the female of *semifasciata* André.

I have not examined the specimen of *unimaculata* recorded from the Celebes by Zavattari (1913), but it probably belongs here.

Odontomutilla unimaculata (Smith).

Mutilla unimaculata Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 87, ♀.
Mutilla unimaculata Dalle Torre, 1897, *Cat. Hymen.*, **8** : 94, ♀.
——— *unimaculata* André, 1903, *Gen. Insect.*, **11** : 71, ♀.

Holotype.—♀, BORNEO: Sarawak, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the unique type.

Differs from related species by the characters mentioned in the discussion of the preceding species.

Odontomutilla semifasciata (André).

Mutilla simplicifascia var. *semifasciata* André, 1896, *Termeszet. Fuzetek*, **19** : 15, ♂.
Odontomutilla simplicifascia var. *semifasciata* André, 1903, *Gen. Insect.*, **11** : 29, ♂.
Odontomutilla simplicifascia var. *semifasciata* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 63, ♂ (in part).

Holotype.—♂, CELEBES : Bonthain, in Hungarian National Museum, Budapest.

Distribution.—CELEBES.

I have not examined Zavattari's specimens, but it is doubtful if the specimens from Solor Island and New Guinea are the same as those from Celebes. This species has been placed in the key by means of an examination of the holotype.

Odontomutilla simplicifascia (Sich. & Rad.).

Mutilla simplicifascia Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 192–193, pl. vii, figs. 3, 4; ♀, ♂.
?*Mutilla simplicifascia* André, 1896, *Termeszet. Fuzetek*, **19** : 15, ♀.
Mutilla simplicifasciata Dalle Torre, 1897, *Cat. Hymen.*, **8** : 86, ♀, ♂.
?*Mutilla simplicifascia* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 581.
Odontomutilla simplicifascia André, 1903, *Gen. Insect.*, **11** : 29, ♀, ♂.
?*Odontomutilla simplicifasciata* Zavattari, 1910, *Ann. Mus. zool. Univ. Napoli*, (3) **9** : 4, ♂.
?*Odontomutilla simplicifascia* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 63, ♀.

Holotype.—♀, Gilolo. Location unknown.

Allotype.—♂, Gilolo. Location unknown.

Specimens examined.—♂, Gilolo.

I have not had an opportunity to examine the types of this species. None of the specimens from neighbouring regions, which I have seen, corresponds to the description and figures given by Sichel and Radoskowski. I am of the opinion that the specimens recorded by André, Mantero, and Zavattari are not the same as this species, although I have been unable to examine their material.

Odontomutilla inanis sp. n.

♀. Head, abdomen and legs, black, the thorax entirely ferruginous; lateral margins of mesonotum with a prominent, anterior, blunt tooth; second abdominal tergite entirely black, without a median, anterior, pale pubescent spot; third tergite with a broad band of pale pubescence, distinctly interrupted medially with black. Length, 12 mm. *Head* entirely black, except the mandibles medially and the flagellum beneath tinged with ferruginous; mandibles comparatively slender, edentate at the apex and with a small tooth within near the apex; median triangular area of clypeus elevated, the surface slightly concave, with a transverse carina posteriorly near the apex of the triangle, and the lateral margins prominently angulate medially, clothed with sparse, erect, pale pubescence; scape finely, densely punctate beneath, glabrous, almost impunctate above; first segment of flagellum distinctly longer than the second when viewed from beneath, the second much broader than long; antennal scrobes very strongly carinate above; front, vertex and genae with large, dense, deep, confluent punctures, clothed with sparse, erect, fuscous pubescence, that on the genae paler than elsewhere; posterior margin of genae defined by a strong carina; gular margin strongly carinate and prominently angulate posterior to the insertion of the mandibles, the angle almost forming a tooth; head not well developed behind the eyes, the distance between the eye-margins and the postero-lateral angles equal to one-half the greatest diameter of the eyes; relative widths of head and thorax at its widest point, 4·6–5·6. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, ferruginous pubescence, the posterior face of propodeum with sparse, long, fuscous pubescence, and the pleural areas with sparse, pale micropubescence and scattered, long pubescence at the posterior margin of mesopleurae and on sides of propodeum; dorsum coarsely, longitudinally rugoso-punctate; scutellar scale entirely absent; humeral angles subacute, not prominent, the lateral margins of prothorax with a small blunt tubercle just behind the humeral angles; lateral margins of mesonotum with a prominent, blunt tooth anteriorly; rugae of dorsum extending on to anterior fourth of posterior face of propodeum, the remainder of the latter with moderately small, separated punctures; anterior margin of propleurae defined by a high, sharp carina; pleural areas micropunctate, the posterior margin of mesopleurae and postero-ventral area of metapleurae also with moderate, close, confluent punctures, and the sides of propodeum also with moderate, scattered punctures. *Abdomen* entirely black, clothed with sparse, erect and recumbent, black pubescence except the lateral areas of the second tergite, and all the sternites with sparse, pale pubescence, sternites two to five with apical fringes of pale pubescence, and the third tergite with a band of dense, appressed, pale pubescence, interrupted medially with black; anterior face of first tergite angulately separated from the dorsal face, and with moderate, distinct punctures; dorsal face of first tergite with small, dense, confluent punctures; second tergite with a large deep fovea, about twice as long as broad, at the antero-lateral angles; second tergite with large, dense, confluent punctures anteriorly, the latter gradually becoming smaller posteriorly, at the apex small, close, distinct, the apical margin glabrous, impunctate; last tergite with dense, moderate punctures, appearing asperated, a median, posterior area with the sculpture less coarse; first sternite with a median, longitudinal, high carina on the anterior third; second sternite with large, separated punctures, the latter small at the posterior margin; sternites three to five and the hypopygium with moderately small, dense punctures. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale ferruginous.

♂. Head, abdomen, sternum of thorax, and legs black, the thorax ferruginous except the sternum; postero-lateral angles of dorsum of propodeum angulate, but not prominently produced; third tergite with a moderately narrow band of dense, appressed, pale pubescence, broadly interrupted medially; wings fuscous. Length, 12 mm. *Head* entirely black, the front and vertex with sparse, pale ferruginous pubescence, elsewhere with sparse, pale, glittering pubescence; mandibles moderately robust, edentate at the apex and with two small teeth within near the apex; median, triangular area of clypeus elevated, the lateral margins prominently so, with a pair of median tubercles, densely punctate behind the tubercles, glabrous almost impunctate anterior to the tubercles; scape indistinctly carinate beneath with fine, close punctures; first segment of flagellum about two-thirds the length of the second; antennal scrobes distinctly carinate above; front, vertex and genae with moderately large, dense, confluent punctures; posterior margin of genae defined by a carina; gular carina elevated into a small tooth posterior to the insertion of the mandibles; relative widths of head and thorax at the tegulae, 4·2–5·6. *Thorax* entirely ferruginous, except the sternum blackish, clothed throughout with rather long, erect, sparse, pale ferruginous pubescence, except the propleurae and metapleurae pale micropubescent; pronotum, mesonotum and scutellum with large, close, confluent punctures, except the posterior margin of the pronotum glabrous, impunctate; humeral angles angulate but not prominent; parapsidal furrows obscure; dorsum and posterior face of propodeum rounded into one another, broadly reticulate throughout; postero-lateral angles of dorsum of propodeum distinctly angulate but not prominently produced; anterior margin of propleurae strongly defined by a carina; propleurae micropunctate and with scattered obscure moderate punctures; mesopleurae with large, close, confluent punctures; metapleurae micropunctate, except postero-ventrally with large, close punctures; sides of propodeum shallowly reticulate, not as broadly so as the posterior face; tegulae large, extending one-fourth their length beyond the posterior margin of mesonotum, shallowly punctate, and with sparse, ferruginous pubescence throughout. *Abdomen* entirely black, clothed with sparse, black pubescence, except the second and third sternites with sparse, erect, pale pubescence, the third tergite with a moderately narrow band, broadly interrupted medially of dense, appressed, pale pubescence, and lateral thirds of the apical margin of third sternite with dense, appressed, pale pubescence; anterior face of first tergite with scattered, moderate punctures, the dorsal face narrow and with a transverse row of large, close punctures, the latter irregular, not in a straight line; second tergite with moderately large, close, distinct punctures anteriorly and laterally, becoming very sparse on the disk, a narrow median posterior area practically impunctate, and the posterior third with moderately small, close, distinct punctures, becoming dense and confluent at the postero-lateral angles; tergites three to six with moderately small, close, more or less confluent punctures except the posterior margin of each glabrous, impunctate; last tergite with moderately small, dense, confluent punctures throughout; first sternite with a prominent, median, longitudinal carina on the anterior two-thirds; second sternite with large, separated, distinct punctures except a narrow, transverse, apical area with smaller, closer punctures; sternites three to six with moderate, close, more or less confluent punctures; hypopygium with moderate, close punctures, the anterior margin with a distinct, transverse elevated ridge, broadly, shallowly emarginate medially. *Wings* fuscous, with dark purple reflections; cell 2nd $R_1 + R_2$ very broadly truncate at the apex, almost one and one-third times as long as cell $R +$ 1st R_1; cell R_4 entirely obsolete; cell R_5 receiving vein M_{3+4} at the middle; veins *m-cu* and $M_4 + Cu_1$ interstitial. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♀, Papua : Laloki, in University of Minnesota collection.

Allotype.—♂, Papua : Laloki, in University of Minnesota collection.

Related to *simplicifascia* Sich. & Rad., but both sexes have the pale pubescent band of the third tergite interrupted medially. The female is one of three species which lack the anterior, median, pale pubescent spot on the second tergite. The male is characterised by the almost entirely ferruginous thorax.

Odontomutilla ceramensis sp. n.

♂. Head, abdomen and legs, black, thorax entirely ferruginous; postero-lateral angles of dorsum of propodeum prominently produced and subacute; third abdominal tergite with a broad band of dense, appressed, pale pubescence, the band narrowed medially and distinctly interrupted. Length, 15 mm. *Head* entirely black, the front and vertex clothed with sparse, erect, obscure ferruginous pubescence, elsewhere with sparse, pale pubescence; mandibles moderately robust, edentate at the apex and with two small teeth within near the apex; median, triangular area of clypeus elevated with small, dense punctures, the lateral margins of the triangle defined by an elevated carina, the median space with a pair of distinct tubercles; scape obscurely carinate beneath, with close, small and fine punctures; first segment of flagellum about two-thirds the length of the second; antennal scrobes strongly carinate above; front, vertex and genae with large, dense, confluent punctures; posterior margin of genae defined by a distinct carina; gular carina strongly elevated posterior to the insertion of the mandibles forming a distinct tooth; relative widths of head and thorax at the tegulae, 4·8–6·7. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, ferruginous pubescence, the propodeum and mesopleurae with sparse, long, erect, pale pubescence, the propleurae and metapleurae with pale micropubescence; pronotum, mesonotum and scutellum with large, dense, deep, confluent punctures; humeral angles angulate but not prominent; parapsidal furrows obscure; dorsum and posterior face of propodeum rounded into one another, very broadly, conspicuously reticulate; postero-lateral angles of dorsum of propodeum prominently produced, subacute; anterior margin of propleurae defined by a prominent carina; propleurae micropunctate and with scattered, moderately large, obscure punctures; mesopleurae with large, dense, deep, confluent punctures, except at the anterior margin micropunctate; metapleurae micropunctate except the postero-ventral areas with moderately large, close punctures; sides of propodeum reticulate, the meshes smaller and shallower than on the dorsum and posterior face; tegulae large, extending one-fifth their length beyond the posterior margin of the mesonotum, with sparse, moderate, shallow punctures, and sparse, ferruginous pubescence. *Abdomen* entirely black, clothed with sparse, black pubescence, except the first and second tergites and all the sternites with sparse, pale to pale fuscous pubescence, the third sternite with a broad band of dense, appressed, pale pubescence, the band narrowed and distinctly interrupted medially, and the lateral fourths of the second and third sternites with thick, appressed, pale pubescence; anterior face of first tergite with sparse, moderate punctures; dorsal face of first tergite with a narrow, transverse band of moderately large, close, confluent punctures; second tergite with moderately large punctures, close and more or less confluent at the anterior margin and the lateral thirds, an area on the disk extending along the median line to the posterior margin glabrous, practically impunctate, the posterior third with moderately small punctures, distinct and separated medially, close and confluent laterally, and the posterior margin glabrous, impunctate; tergites three to six with moderately small, distinct punctures, except the posterior margin of each glabrous, impunctate; last tergite with moderately small, dense, confluent punctures; first sternite with a prominent, median, longitudinal carina, the posterior half of the carina shallowly, roundly emarginate; second sternite with moderately large, mostly distinct, but somewhat confluent punctures; sternites three to six with moderately small, close punctures; hypopygium with moderately small, dense, confluent punctures. *Wings* fuscous, with dark purple reflections; cell 2nd $R_1 + R_2$ about one and one-third times as long as cell R + 1st R_1 very broadly truncate at the apex; cell R_4 entirely obsolete; cell R_5 receiving vein M_{3+4} slightly before the middle; vein *m-cu* received on vein *Cu* anterior to vein $M_4 + Cu_1$ by two-thirds the length of the latter vein. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, CERAM, January, 1909 (*F. Muir*), in University of Minnesota collection.

Paratypes.—Two ♂♂, CERAM, January, 1909 (*F. Muir*).

Related to *inanis* but differs by having the postero-lateral angles of dorsum of propodeum much more prominent and acute, by the broader and more narrowly interrupted, pale pubescent band on the third tergite, by vein *m-cu* terminating anterior to vein $M_4 + Cu_1$, and by subtle differences in puncturation.

Odontomutilla manifesta (Smith).

Mutilla manifesta Smith, 1859, *J. Proc. linn. Soc., Zool.*, **3** : 150, ♀ and ♂.
Mutilla manifesta André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 69, ♀.
Mutilla manifesta Dalle Torre, 1897, *Cat. Hymen.*, **8** : 57, ♀, ♂.
?*Mutilla manifesta* André, 1898, *Ann. Soc. ent. Fr.*, **67** : 71, ♂.
?*Mutilla manifesta* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 583.
Odontomutilla manifesta André, 1903, *Gen. Insect.*, **11** : 29, ♀, ♂.

Holotype.—♀, and allotype, ♂, ARU ISLAND, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—ISLAND OF ARU and NEW GUINEA.

Easily recognised by the absence of any pale pubescent markings on the abdominal tergites. The types have been examined, but I have not had an opportunity to compare material from New Guinea with the types from Aru to determine whether they are identical. The New Guinea specimens recorded by André and Mantero may possibly be distinct.

Odontomutilla tamensis (Cameron).

Mutilla tamensis Cameron, 1906, *Rés. Exped. Sci. néerland. Nouv.-Guinée* 1903, *Hymén.*, **5** (1) : 50, ♀.
Odontomutilla papuana Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 67, ♀ (**new syn.**).

Holotype.—♀, NEW GUINEA, in Zoologisch Museum, Amsterdam. The type of *papuana* Zavattari is in the Museo Civico di Storia Naturale, Genoa.

Distribution.—NEW GUINEA.

I have examined the types of both *tamensis* and *papuana* and find them to be identical.

Odontomutilla herpa (Cameron).

Mutilla herpa Cameron, 1902, *J. Straits Br. R. asiat. Soc.*, **37** : 73, ♂.

Holotype.—♂, BORNEO : Sarawak, in British Museum (Natural History).

Distribution.—Known only from the type locality.

Characterised by having the pale pubescent band of the third tergite entirely complete without any indication of an interruption. Male specimens of *familiaris* from Borneo occasionally have this same pubescent band apparently complete, but upon close examination it is seen that the pubescence is much thinner medially than elsewhere. The significant differences should be pointed out by comparing specimens of the two species, but I have not found it possible to do this.

Odontomutilla apiastra nom. n.

Mutilla merops Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 115, ♂ (*nec* ♀).

Holotype.—♂, BACHIAN ISLAND, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the unique type.

Smith's original description is based on a ♀ and ♂ specimen, supposedly sexes of the same species. The ♀ holotype of *merops* is an example of the genus *Timulla* (*Trogaspidia*) ; the ♂ specimen belongs to the genus *Odontomutilla*, and is recognisable by the prominent, slightly bifurcate tubercle on the second sternite. Since the name *merops* must be retained for the ♀, I propose the above new name for the ♂.

Odontomutilla rubrocapitata sp. n.

♂. Head and thorax ferruginous, except the thoracic sternum, the ventral portions of the meso- and metapleurae, and the propodeum, entirely black ; abdomen black, the third tergite clothed with dense, pale pubescence ; mesonotum with moderately large, dense, confluent punctures, without a median, longitudinal carina ; lateral margins of pronotum not at all tuberculate ; hypopygium with a median, transversely lamellate turbercle directed slightly caudad. Length, 14 mm. *Head* entirely ferruginous, except the bases and tips of mandibles, proximal four-fifths of the scape, and flagellum entirely black, clothed with sparse, erect, ferruginous pubescence, except that on the genae very pale ; mandibles moderately robust, edentate at the apex and with two small teeth within near the apex ; median triangular area of clypeus elevated, the lateral margins defined by elevated carinae, the surface finely, densely punctate, with a pair of acute tubercles on the anterior half and an obscure transverse arcuate carina a short distance behind the tubercles ; scape with the tips ferruginous, obscurely carinate and finely punctate beneath, finely punctate with intermixed small punctures above ; first segment of flagellum about two-thirds the length of the second ; antennal scrobes distinctly carinate above ; front, vertex and genae with dense, deep, confluent punctures, the moderate ones of the front denser than the large punctures of the vertex and genae; posterior margin of genae defined by a strong carina; gular carina elevated into a low, blunt tooth a short distance behind the insertion of the mandibles; relative widths of head and thorax at the tegulae, 5·1–6·3. *Thorax* ferruginous, except the ventral portions of the meso- and metapleurae, the sternum, and the propodeum, all black; pronotum, mesonotum and scutellum with large, dense, deep, confluent punctures, clothed with sparse, erect, ferruginous pubescence, the mesonotum without a median, longitudinal carina; humeral angles subangulate, not prominent; lateral margins of pronotum not at all tuberculate; dorsum and posterior face of propodeum rounded into one another, broadly, distinctly reticulate, clothed with scattered, long, erect, and sparse, short, appressed, pale, glittering pubescence; postero-lateral angles of propodeum prominently produced, acute; anterior margin of propleurae defined by a strong carina; propleurae with dense, obscure, confluent punctures, and sparse, pale pubescence; mesopleurae with moderately large, dense, confluent punctures and sparse, erect, pale pubescence, except anteriorly micropunctate and micropubescent; metapleurae micropunctate and micropubescent, except postero-ventrally with dense, moderate, confluent punctures; sides of propodeum reticulate, the meshes smaller than on the posterior face, and with sparse, erect, pale pubescence; tegulae ferruginous, large, extending one-fourth their length beyond the posterior margin of the mesonotum, sparsely clothed with ferruginous pubescence, and the distal area obscurely, transversely rugose. *Abdomen* entirely black, clothed with sparse, erect, pale pubescence, except the last four tergites with sparse, erect, black pubescence, sternites four to six and the hypopygium with sparse, erect, fuscous pubescence, the third tergite clothed with dense, appressed, pale pubescence, and the lateral fourths of the apical margins of the second and third sternites with thick, appressed, pale pubescence; anterior face of first tergite with sparse, moderate punctures; anterior margin of dorsal face of first tergite with moderate, dense, confluent punctures, the remainder glabrous, impunctate; the two faces of the first tergite not sharply separated; second tergite with large, sparse punctures on the disk, anteriorly and laterally of the median area the punctures becoming smaller, closer and confluent, immediately posterior along the median line, glabrous, impunctate, the posterior fourth with moderate punctures, separated medially, becoming close and confluent at the sides; puncturation of third tergite mostly obscured by the pale pubescence; tergites four to six with moderately small, distinct punctures medially, becoming close and confluent laterally, except the posterior margin of each tergite glabrous, impunctate; last tergite with moderate dense, confluent punctures; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite with large, close, slightly confluent punctures, becoming smaller and closer towards both the anterior and posterior margins; sternites three to six with sparse, moderately small punctures medially, the latter becoming dense and close laterally; hypopygium with small, dense, confluent punctures, the anterior margin with a median, transversely lamellate, low tubercle. *Wings* fuscous with dark purple reflections; cell 2nd $R_1 + R_2$ very broad, slightly more than twice as long as broad, one and one-fourth times as long as cell $R +$ 1st R_1, and broadly, squarely truncate at the apex; cell R_4 obsolete; cell R_5 receiving vein M_{3+4} two-fifths the distance from base to apex; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale ferruginous.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50036 United States National Museum.

Paratype.—♂, Borneo: Bettotan, near Sandakan, August 18, 1927 (*C. B. K.* and *H. M. P.*).

Related to *haematocephala* André and *aspratilis*, the following species. Differs from both as indicated in the key.

Odontomutilla aspratilis sp. n.

♂. Head and thorax ferruginous, except the central portions of meso- and metapleurae, and propodeum entirely, black; abdomen and legs, black; third abdominal tergite clothed with dense, appressed, pale pubescence, the band of pubescence noticeably narrowed and much thinner medially; lateral margins of pronotum with a low, blunt tubercle slightly anterior to the middle; disk of second abdominal segment with the punctures large and coarse; anterior margin of hypopygium without a median tubercle. Length, 14 mm. *Head* ferruginous, except the bases and tips of mandibles, and the antennae, black, clothed with sparse, erect, ferruginous pubescence, except that on the genae pale; mandibles moderately robust, edentate at the apex and with two small teeth within near the apex; median, triangular area of clypeus elevated, the lateral margins defined by a distinct carina, with small, dense punctures, and with a pair of tubercles slightly anterior of the median, transverse line, but without a transverse carina posterior to the tubercles; scape distinctly bicarinate beneath, the tips ferruginous, with small, close punctures; first segment of flagellum about three-fourths the length of the second; antennal scrobes distinctly carinate above; front, vertex and genae with dense, deep, confluent punctures, those on the front moderately large, on the vertex and genae, large; posterior margin of genae defined by a strong, sharp carina; gular carina elevated into a low, blunt tooth posterior to the insertion of the mandibles; relative widths of head and thorax at the tegulae, 4·6–6·1. *Thorax* ferruginous, except the ventral portions of meso- and metapleurae, and propodeum entirely black; pronotum, mesonotum and scutellum with large, very deep, dense, confluent punctures, and clothed with sparse, erect, ferruginous pubescence; humeral angles distinctly angulate; lateral margins of pronotum with a low, blunt tubercle slightly anterior to the middle; mesonotum without a median, longitudinal carina; dorsum and posterior face of propodeum rounded into one another, clothed with scattered, long, erect, and sparse, short, subappressed, pale pubescence, and very broadly reticulate; anterior margin of propleurae defined by a strong carina; propleurae micropunctate and pale micropubescent, as well as with moderate, close, confluent punctures posteriorly; mesopleurae with large, dense, deep, confluent punctures, clothed with sparse, erect, pale pubescence, except the anterior margin micropunctate and micropubescent; metapleurae micropunctate and micropubescent, except the posteroventral area with moderate, close, confluent punctures; sides of propodeum reticulate, but the meshes distinctly smaller than on the posterior face; tegulae ferruginous, large, extending almost one-third of their length beyond the posterior margin of mesonotum, clothed with sparse, ferruginous pubescence. *Abdomen* entirely black, the first three segments with sparse, erect, pale pubescence, and the third tergite as well as the lateral fifths of the third sternite with dense, appressed, pale pubescence, the band of the latter distinctly narrowed and thinner medially, the remaining segments clothed with sparse, erect, black pubescence; anterior face of first tergite with sparse, large punctures; anterior margin of dorsal face of first tergite with large, close, confluent punctures, the remainder glabrous and impunctate; two faces of the first tergite not sharply separated; second tergite medially with large, elongate, mostly well separated punctures, becoming smaller anteriorly and laterally, the lateral areas with moderately large, close, distinct punctures, the posterior fourth with moderately small punctures, very sparse medially, close but distinct laterally; third tergite finely punctate, the puncturation largely obscured by the pubescence; tergites four to six with small, sparse, distinct punctures; last tergite with moderately small, close, only slightly confluent punctures; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite with moderately large, sparse punctures; sternites three to six with moderately small, close, distinct punctures; hypopygium with moderately small, close, slightly confluent punctures, the anterior margin simple, without a median tubercle. *Wings* fuscous with dark purple reflections; cell

2nd $R_1 + R_2$ very broad, almost half as broad as long, and one and one-fourth times as long as cell R + 1st R_1; cell R_4 entirely obsolete; cell R_5 receiving vein M_{3+4} at two-fifths the distance from base to apex; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale ferruginous.

Holotype.—♂, BORNEO: Bettotan, near Sandakan, August 21, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratype.—♂, BORNEO: Bettotan, near Sandakan, August 22, 1927 (*C. B. K.* and *H. M. P.*).

Related to *rubrocapitata*, but differs in having the clypeus without a transverse carina behind the tubercles, in the more distinctly carinate scape, the tuberculate lateral margins of the pronotum, the coarser puncturation of the second tergite, and the absence of a tubercle on the anterior margin of the hypopygium.

Odontomutilla thymele sp. n.

♀. Head and thorax, ferruginous, except the scape and the flagellum above, black; abdomen and legs, black; second tergite with a median, anterior spot of dense, pale pubescence, narrowed and almost interrupted medially; antero-lateral pubescent fovea of second tergite comparatively short, two and one-half times as long as wide; anterior two-thirds of second tergite deeply, longitudinally striato-punctate. Length, 10 mm. *Head* ferruginous, except the tips of the mandibles, scape, and flagellum above, black; mandibles slender, edentate at the tip and with a very small tooth within near the apex; median, triangular area of clypeus elevated, the lateral margins defined by a carina, and a pair of distinct tubercles posteriorly near the apex, the area anterior to the tubercles glabrous, posterior to the tubercles densely punctate; scape ferruginous at the tip and with small, close punctures; first segment of flagellum slightly longer than the second, the latter broader than long; antennal scrobes strongly carinate above; front, vertex and genae with large, dense, deep, confluent punctures; posterior margin of genae defined by a strong carina; gular carina elevated into a low, blunt tooth posterior to the insertion of the mandibles; head only moderately developed behind the eyes, the distance between the eye-margins and the postero-lateral angles equal to half the greatest diameter of the eyes; relative widths of head and thorax, 4·2–4·5. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, ferruginous pubescence, the posterior face of propodeum and posterior margin of mesopleurae with long, sparse, erect, pale pubescence, the remainder of the pleural areas pale micropubescent; dorsum of thorax strongly, irregularly, longitudinally striato-punctate; lateral margins of dorsum of thorax slightly converging towards the rear, the propodeum not noticeably narrowed; humeral angles angulate but not prominently so; lateral margins of dorsum of thorax crenulate without distinct teeth; striae of dorsum of thorax extending on to the anterior fourth of posterior face of propodeum, the latter moderately punctate; anterior margin of propleurae defined by a distinct carina; propleurae micropunctate; posterior margin of mesopleurae with moderate, close, confluent punctures, the remainder of mesopleurae micropunctate; metapleurae micropunctate except for a few moderate punctures postero-ventrally; sides of propodeum micropunctate as well as with scattered small punctures. *Abdomen* entirely black, the anterior face of the first tergite and all the sternites with sparse, erect, pale pubescence, all the tergites elsewhere with sparse, black pubescence, except the second with a small, subcircular, anterior, median spot, and the third tergite with a broad band narrowed and subinterrupted medially of dense, appressed, pale pubescence; anterior face of first tergite with small, sparse punctures; dorsal face of first tergite with small, dense, confluent punctures; the two faces of the first tergite separated by a transverse carina; antero-lateral pubescent fovea of second tergite short, only two and one-half times as long as broad; anterior two-thirds of second tergite strongly, deeply, longitudinally striato-punctate, the striae becoming obscure towards the lateral margins, the posterior third of the tergite with small, close, distinct punctures; tergites three to five with small, shallow, mostly separated punctures, except the posterior margin of each tergite glabrous, impunctate, and the punctures on tergite three largely obscured by the pale pubescence; last tergite finely asperated, except along the median line on the posterior half finely, transversely striated; first sternite with a median carina on the anterior half; second sternite with moderate, distinct punctures; sternites three to six with small, close punctures; hypopygium with small, distinct punctures. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale ferruginous.

Holotype.—♀, Borneo: Bettotan, near Sandakan, July 30, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratype.—♀, Borneo: Bettotan, near Sandakan, August 9, 1927 (*C. B. K.* and *H. M. P.*).

Related to *pompalis*, the following species, but differs in having the antero-lateral pubescent fovea shorter and smaller, and the second tergite more strongly striato-punctate. The anterior, median, pubescent spot on the second tergite of the paratype is rubbed off.

Odontomutilla pompalis sp. n.

♀. Head and thorax ferruginous; abdomen and legs black; dorsum of thorax densely punctate, but not striato-punctate; lateral margins of mesonotum distinctly angulate anteriorly; second tergite with a median, anterior, subtriangular spot of dense, appressed, pale golden pubescence; antero-lateral pubescent fovea of second tergite long, slightly more than three times as long as broad; pale pubescent band of third tergite narrowed medially but not interrupted. Length, 12·5 mm. *Head* ferruginous, except the bases and tips of mandibles, the scape, and the flagellum above, black; clothed with sparse, erect, ferruginous pubescence, except the genae with pale pubescence; mandibles slender, edentate at the apex, and with a small tooth within near the apex; median, triangular area of clypeus elevated, the lateral margins of the elevation produced medially into a conspicuous tubercle, the surface with a transverse carina posteriorly near the apex, finely densely punctate anterior to the carina, coarsely punctate posterior to the carina; tip of the scape ferruginous; scape finely punctate; first segment of flagellum one and one-fourth times as long as the second, the latter broader than long; antennal scrobes strongly carinate above; front, vertex and genae with large, dense, confluent punctures; posterior margin of genae defined by a carina; gular carina elevated into a low, blunt tooth posterior to the insertion of the mandibles; relative widths of head and thorax, 5·2–6·0. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, ferruginous pubescence, the posterior face of propodeum and posterior margin of mesopleurae with sparse, long, erect, pale pubescence, the pleural areas elsewhere micropubescent; dorsum of thorax with large, dense, deep, confluent punctures, only obscurely, longitudinally striato-punctate; humeral angles subangulate, not prominent; lateral margins of mesonotum distinctly angulate just behind the anterior spiracle; lateral margins of dorsum of thorax slightly converging towards the rear, the propodeum not noticeably narrowed; sculpture of dorsum of thorax extending on to the anterior fourth of the posterior face of propodeum, the remainder of the latter moderately punctate; anterior margin of propleurae defined by a carina; propleurae micropunctate and with obscure, moderate punctures; posterior margin of mesopleurae with moderate, dense, confluent punctures, elsewhere the mesopleurae micropunctate; metapleurae micropunctate, except postero-ventrally with moderate, confluent punctures; sides of propodeum micropunctate as well as with sparse, obscure, moderate punctures. *Abdomen* entirely black, the anterior face of the first tergite, lateral fourths of the second tergite, posterior third of last tergite and all the sternites with sparse, erect, pale pubescence, the remainder of the tergites with sparse, erect, black pubescence, except the second with an anterior, median, subtriangular, pale golden pubescent spot, the third with a broad band of dense, appressed, pale pubescence, narrowed medially, but not interrupted, and the lateral thirds of second and third sternites with thick, appressed, pale pubescence; anterior face of first tergite with moderately small, distinct punctures; dorsal face of first tergite with moderately small, dense, confluent punctures; the two faces of the first tergite distinctly separated; antero-lateral pubescent fovea of second tergite somewhat more than three times as long as broad; anterior half to two-thirds (half medially, two-thirds laterally) of second tergite with large, dense, confluent punctures, appearing obscurely longitudinally striato-punctate, laterally the punctures somewhat smaller and not striato-punctate; posterior half (at middle) to third (laterally) with small, dense, slightly confluent punctures, the posterior margin of the second tergite glabrous, impunctate; tergites three to six with small, dense, confluent punctures, those on the third obscured by the pale pubescence, and each tergite with the posterior margin glabrous, impunctate; last tergite with small, dense, confluent punctures, except along the midline on the posterior half, finely, transversely striated; first sternite with a low, median, longitudinal carina on the anterior two-thirds; second sternite with moderately large, close punctures, except the broad posterior margin with moderate dense punctures; sternites three to six and hypopygium with small, dense, confluent punctures. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria ferruginous.

Holotype.—♀, BORNEO: Bettotan, near Sandakan, August 14, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Related to *thymele* and *urania*; differs from the first in the longer antero-lateral pubescent fovea, the angulate margin of mesonotum, and sculpture of dorsum of thorax and second tergite; from the latter differs in the angulate margin of mesonotum, less coarsely sculptured dorsum of thorax as well as second abdominal tergite.

Odontomutilla haematocephala (André).

Mutilla simplicifascia var. *haematocephala* André, 1896, *Termeszet. Fuzetek*, **19** : 16, ♂.
Odontomutilla simplicifascia var. *haematocephala* André, 1903, *Gen. Insect.*, **11** : 29, ♂.

Holotype.—♂, FEDERATED MALAY STATES: Perak. Although André (1896) stated that a single individual was in his collection I was unable to locate the type in his material now in the Muséum d'Histoire Naturelle at Paris.

Specimens examined.—♂, FEDERATED MALAY STATES: Gonbak Valley, Selangor, October 20, 1921 (*H. M. Pendlebury*).

The above specimen agrees exactly with the original description and comes from the vicinity of the type locality; I think there can be little question that this is André's *haematocephala*. It should rank as a species and not as a variety of *simplicifascia* which differs not only in the colour of the head and propodeum, but has the postero-lateral angles very much less produced and is differently sculptured.

Odontomutilla urania (Smith).

Mutilla urania Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 83, ♀ (*nec* ♂).
Mutilla urania André, 1896, *Termeszet. Fuzetek*, **19** : 12, ♀.
Mutilla urania Dalle Torre, 1897, *Cat. Hymen.*, **8** : 94, ♀, (*nec* ♂).
Mutilla urania André, 1898, *Ann. Soc. ent. Fr.*, **67** : 31, ♀ (in part).
Odontomutilla urania André, 1903, *Gen. Insect.*, **11** : 30, ♀ (in part).

Holotype.—♀, MALAY PENINSULA: Mt. Ophir, in Saunders' coll., Hope Dept. Oxford University.

The original description of this species by Smith cited Sarawak, Borneo, as the type locality. I have examined the types in the Saunders' collection and find that both bear locality labels, " Mt. Ophir," and a specimen from the Malay Peninsula which I have compared with the type is identical with it. None of the species known from Borneo agrees with the type specimen. The material covered in Smith's (1858) paper came from Borneo, Mt. Ophir and Singapore. It appears likely that the citation of the type locality as " Borneo " was an error and that the correct type locality is Mt. Ophir, Malacca.

The specimen described by Smith as the male of this species is an example of the genus *Timulla* (*Trogaspidia*). There can be no question that the two are incorrectly correlated, so that the male of *urania* is still unknown. It is very probable that *haematocephala* André may be the male sex.

Former authors have looked upon the species included in this genus as extremely variable in sculpture and colour, thus specimens very different in appearance from widely different localities have been recorded as the same species. This is especially true of *simplicifascia* Sich. & Rad., and of *urania* Smith. The present study has shown that most of the species are not widely distributed but are confined to single islands or very closely adjacent ones. Thus André (1898, 1903) recorded *urania* from Cambodge, Laos, China, Borneo, Sumatra. The result is that *urania* Aucct. is a composite, representing several different species. *O. urania* should be regarded as distributed only in Malaysia until a critical examination of specimens from other localities demonstrates a wider geographical distribution. Cameron (1905) regarded *buddha*, a species from India described by him, as a variety of *urania* because it has a black head. This is probably not correct. None of the species, which I have examined, of this genus, having ferruginous heads is at all similar to those having black heads. *O. buddha* Cameron should be regarded as a distinct species until it can be definitely shown that such a view is incorrect. André (1896, 1898) also suggested that *cordigera* Sich. & Rad., and *sinensis* Smith were the same as *urania*. I have examined the types of both *cordigera* and *sinensis* and find them to be very different from *urania*.

Specimens examined.—♀, MALAY PENINSULA : Kuala Teku, July 28, 1905 (*H. C. Robinson*). This is the specimen mentioned above as having been compared with the holotype; it is in the collection of the British Museum (Natural History).

Odontomutilla grossa sp. n.

♀. Head, except mandibles and antennae, and thorax, ferruginous; abdomen and legs, black; second tergite with a large, anterior, median, subtriangular spot, and third tergite with a very broad band narrowed and narrowly interrupted medially, of dense, appressed, pale pubescence; lateral margins of mesonotum with a very prominent, bluntly rounded tooth anteriorly; vertex and dorsum of thorax with a distinct, slightly sinuate, median, longitudinal carina; longitudinal rugae of dorsum of thorax interrupted by posterior margin of mesonotum. Length, 18 mm. *Head* ferruginous, except the mandibles and flagellum black, the latter tinged with ferruginous beneath, clothed with sparse, erect, fuscous pubescence, except the genae and clypeus with the pubescence pale; mandibles comparatively slender, edentate at the apex and with a small tooth within near the apex; median, triangular area of clypeus elevated, strongly so on the posterior half, the lateral margins not distinctly carinate, the surface with a prominent, arcuate, transverse carina at the anterior portion of the posterior half; lateral margins of median area of clypeus distinctly angulate just anterior to the transverse carina, the area posterior to the latter densely, confluently punctate, the anterior area vertical and for the most part glabrous, impunctate; scape finely punctate beneath, above glabrous, impunctate; first segment of flagellum slightly longer than the second, especially when viewed from beneath, the second segment broader than long; antennal scrobes strongly carinate above; front, vertex and genae with very large, coarse, dense, confluent punctures; vertex with a thick, median, longitudinal carina; posterior margin of genae defined by a strong carina; gular carina very strongly angulate posterior to the insertion of the mandibles; relative widths of head and thorax, 6·7–9·1. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, fuscous pubescence, the posterior face of propodeum and posterior margin of mesopleurae with sparse, long, erect, pale pubescence, elsewhere the pleural areas with pale micropubescence; humeral angles distinctly angulate though not prominent; lateral margins of pronotum with a median, small, blunt tooth; lateral margins of mesonotum with a very prominent, large, bluntly rounded tooth just behind the anterior spiracles; posterior margin of mesonotum margined thus interrupting the longitudinal rugae of the dorsum; scutellar scale entirely absent; dorsum of thorax very coarsely, deeply, longitudinally rugoso-punctate, the pronotum and mesonotum with a thick, median, longitudinal carina; rugae of dorsum extending on to the anterior third of posterior face of propodeum; remainder of propodeum moderately punctate; anterior margin of propleurae defined by a distinct carina; propleurae micropunctate as well as with scattered, moderate, obscure punctures; posterior margin of mesopleurae with moderate, dense, confluent punctures, the remainder of mesopleurae micropunctate; metapleurae micropunctate, except postero-ventrally with moderate, confluent punctures; sides of propodeum micropunctate and with scattered, moderate punctures. *Abdomen* entirely black, the anterior face of first tergite, the last tergite and all the sternites clothed with sparse, erect, pale pubescence, the remainder of the tergites with sparse, black pubescence, except the postero-lateral angles of the second and the lateral margins of the fifth with long, sparse, pale pubescence, and with dense, appressed, pale pubescence as follows: a large, median, anterior, subtriangular spot on the second tergite, a very broad band on the third tergite, narrowed and narrowly interrupted medially, and the lateral thirds of the apical margins of the second and third sternites; anterior face of first tergite with moderately, large distinct punctures; dorsal face of first tergite with small, dense, confluent punctures throughout; the two faces of the first tergite sharply separated; anterolateral pubescent fovea of second tergite very large and elongate, more than three times as long as broad; anterior half (at middle) to two-thirds (laterally) of second tergite coarsely, longitudinally rugoso-punctate, the rugae becoming obsolete laterally, thus only the coarse punctures remaining; posterior half (at middle) to third (laterally) of second tergite with small, dense, more or less confluent punctures, except the narrow, apical margin glabrous, impunctate; tergites three to five with small, dense, somewhat confluent punctures, those on the third tergite obscured by the dense, pale pubescence, except each tergite with the apical margin glabrous, impunctate; last tergite finely asperated, except a narrow area along the longitudinal midline granulate to finely, transversely striate; first sternite with a median, low, longitudinal carina on the anterior two-thirds; second tergite with moderately large punctures, sparse medially, close and somewhat smaller laterally, close, small and confluent posteriorly; sternites three to five, and hypopygium with moderately small, close, slightly confluent punctures. *Legs* entirely black, sparsely clothed with erect, pale pubescence, the intermediate and posterior tibiae externally with thick, appressed, pale pubescence; calcaria ferruginous.

Holotype.—♀, W. Borneo: Mowong, September, 1907 (*F. Muir*), in University of Minnesota collection.

Very distinct by its large size, sculpture of the thorax and abdomen, and the dentate lateral margins of mesonotum.

Odontomutilla taiwaniana Zavattari.

Odontomutilla taiwaniana Zavattari, 1913, *Arch. f. Naturges.*, **79a** (3) : 24, ♀ and ♂.
Odontomutilla taiwaniana Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 388, ♀ and ♂.

Holotype.—♀, Formosa : Taihorin, May, 1909 (*H. Sauter*).

Allotype.—♂, Formosa (*H. Sauter*). Both holotype and allotype in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

Odontomutilla andromeda Mickel.

Odontomutilla andromeda Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 139, ♀ and ♂.

Holotype.—♂, Philippine Islands : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Allotype.—♀, Philippine Islands : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : Luzon, Samar, Negros and Mindanao.

Odontomutilla pedaria Mickel.

Odontomutilla pedaria Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 135, ♂ and ♀.

Holotype.—♂, Philippine Islands : Iligan, Mindanao (*Baker*), in United States National Museum.

Allotype.—♀, Philippine Islands : Iligan, Mindanao (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : Mindanao, Basilan and Palawan.

Odontomutilla cassiope (Smith).

Mutilla cassiope Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 86, ♀.
Mutilla cassiope Dalle Torre, 1897, *Cat. Hymen.*, **8** : 21, ♀.
Odontomutilla cassiope André, 1903, *Gen. Insect.*, **11** : 29, ♀.

Holotype.—♀, Borneo : Sarawak, in Saunders' coll., Hope Dept. Oxford University.

The male sex has heretofore been undescribed. The description follows :

♂. Head, abdomen, intermediate and posterior tibiae, and all the tarsi, black; thorax, coxae, trochanters, femora and front tibiae, ferruginous; postero-lateral angles of dorsum of propodeum rounded, not at all produced; disk of second tergite evenly punctate throughout; third tergite with a complete, appressed, pale pubescent band; wings subhyaline with a darker cloud in cells $R +$ 1st R_1, 2nd $R_1 + R_2$ and R_5. Length, 6·5 mm. *Head* black, except the mandibles medially, apices of the scape, and pedicel, ferruginous; clothed with sparse, erect, pale fuscous pubescence; mandibles slender, edentate at the apex and apparently with a single tooth within near the apex; median, triangular area of clypeus elevated, the posterior half densely punctate, the anterior half glabrous, impunctate; scape finely punctate, not carinate beneath; first segment of flagellum about half the length of the second; antennal scrobes carinate above; front, vertex and genae with moderate, dense, confluent punctures; posterior margin of genae defined by a carina; gular carina elevated into a small, acute tooth posterior to the insertion of the mandibles; relative widths of head and thorax at the tegulae, 2·6–2·8. *Thorax* entirely ferruginous, the pronotum, mesonotum and scutellum clothed with sparse, erect, ferruginous pubescence, the posterior face of propodeum and mesopleurae with sparse, pale pubescence, the remainder of the pleural areas pale micropubescent; humeral angles acutely angulate but not conspicuous; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures; dorsum and posterior face of propodeum rounded into one another, broadly reticulate; anterior margin of propleurae defined by a sharp carina; propleurae micropunctate; mesopleurae with moderate, shallow, confluent punctures except the anterior margin micropunctate; metapleurae micropunctate, except a few moderate punctures postero-ventrally; sides of propodeum shallowly reticulate, the meshes much smaller than on the dorsum and posterior face; tegulae large, ferruginous, sparsely clothed with ferruginous pubescence. *Abdomen* entirely black, the first four segments with sparse, erect, pale pubescence, the remaining segments with similar fuscous pubescence, except the third tergite with a broad, complete band of dense, appressed, pale pubescence; anterior face of first tergite with scattered punctures; dorsal face of first tergite with moderately small, confluent punctures, except the posterior margin glabrous, impunctate; dorsal and anterior faces of first tergite sharply separated; second tergite with sparse, moderately large punctures on the disk, anteriorly and laterally the punctures closer, posteriorly the punctures smaller and closer; tergites three to six with small, sparse punctures, except the posterior margin of each glabrous, impunctate; last tergite with small, dense, confluent punctures; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina elevated posteriorly into a distinct tooth; second sternite with moderate, distinct punctures; sternites three to six with small, close punctures; hypopygium with small, dense punctures. *Wings* subhyaline, with a darker cloud in cells R + 1st R_1, 2nd $R_1 + R_2$, and R_5; cell 2nd $R_1 + R_2$ rounded apically, one and two-thirds times as long as cell R + 1st R_1; cell R_4 entirely obsolete; cell R_5 receiving vein M_{3+4} at two-fifths the distance from base to apex; vein *m-cu* interstitial with vein $M_4 + Cu_1$. *Legs* ferruginous, except the intermediate and posterior tibiae and all the tarsi, black, clothed with sparse, pale pubescence; calcaria pale.

Allotype.—♂, BORNEO: Bettotan, near Sandakan, August 23, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Specimens examined.—Seven ♀♀, BORNEO: Sandakan (*Baker*); ♀, two ♂♂, BORNEO: Bettotan, near Sandakan, August 22, 1927 (*C. B. K.* and *H. M. P.*).

This species as well as the three preceding ones form a section of the genus *Odontomutilla* in which the females lack an antero-lateral pubescent fovea on the second tergite, and the males do not have the postero-lateral angles of the dorsum of propodeum angulate or produced. Since only the female of one species of this section, *cassiope*, is known from Borneo, there can be little question that the single species represented in the male sex from the same locality is the male of *cassiope*. The specimen recorded by André (1896) from Malacca as this species probably represents a fifth species belonging to this section. The females enumerated above have been compared with the holotype.

SPECIES UNKNOWN TO ME.

Odontomutilla subinterrupta Zavattari.

Odontomutilla simplicifasciata var. *subinterrupta* Zavattari, 1910, *Ann. Mus. zool. Univ. Napoli*, 3 (9) : 4, ♂.

Odontomutilla simplicifascia var. *subinterrupta* Zavattari, 1913, *Boll. Soc. ent. ital.*, 15 : 64, ♂ (in part).

Type.—♂, JAVA. Probably in Zoological Museum of the University of Naples.

I have not had an opportunity to study the type of this species and am unable to recognise it from the description. It is probably close to the male of *familiaris* Smith. The specimens recorded by Zavattari (1913) probably represent more than one species.

Timulla (*Trogaspidia*) Ashmead.

Key to the Species.

♂♂.

1. Hypopygium with lateral, elevated ridges, usually terminating in a distinct tubercle, or with a pair of anterior tubercles; scutellum usually distinctly gibbose, rarely not at all gibbose, only slightly convex . . . . . . 2.

Hypopygium simple, without ridges or tubercles; scutellum not gibbose, only slightly convex . . . . 59.

2. Scutellum distinctly although sometimes only slightly, gibbose; second abdominal sternite evenly convex laterally . . . . 3.

Scutellum not at all gibbose, only slightly convex; second sternite longitudinally gibbose near the lateral margins . . . . *bataviana* (André).

3. Mandibles not excised beneath . . . . 4.

Mandibles deeply excised beneath . . . . 9.

4. Pronotum clothed with sparse, black pubescence . . . . 5.

Pronotum clothed with dense, appressed, pale pubescence . . . . . 6.

5. Abdominal segments 2-5 ferruginous . *philippinensis philippinensis* (Smith).

Abdomen entirely black . . . . . . *philippinensis itambusa* Cockerell.

6. Dorsum of propodeum clothed with dense, appressed, pale pubescence *philippinensis malayana* (Cameron).

Dorsum of propodeum sparsely clothed with subappressed, pale pubescence 7.

7. Elevation of median, longitudinal line of clypeus weak, not prominent; abdominal segments 2–6 ferruginous . . . . 8.

Elevation of median, longitudinal line of clypeus strong, forming a prominent, dull carina; only abdominal segments 2–4 ferruginous *philippinensis singapora* subsp. n.

8. Disk of second tergite with distinct, sparse punctures; apical fringe of sixth tergite ferruginous . . . . *philippinensis amartana* (Zavattari).

Disk of second tergite almost entirely glabrous, impunctate; apical fringe of sixth tergite black . . . . *philippinensis sunda* subsp. n.

9. Clypeus with a prominent transverse, submarginal carina anteriorly, extending the entire width of the clypeus . . . . 10.

Clypeus not transversely carinate anteriorly, or if so, the carina limited to the median area . . . . 18.

10. At least the second abdominal segment ferruginous, and one or more apical segments black . . . . 11.

Abdominal segments 1–3, and the basal half of the fourth, black, the apical segments ferruginous . . . . *haemarrhoa* (Zavattari).

11. Tegulae glabrous, impunctate . . . . 12.

Tegulae finely punctate . . . . *tegularia* Mickel.

12. First five abdominal segments ferruginous; pronotum with thick to dense, appressed, pale pubescence . . . . 13.

Only the first two abdominal segments ferruginous; pronotum without appressed, pale pubescence; tergites 3 and 4 with an apical band of moderately thick, pale pubescence . . . . *pustulata* (Smith).

13. Lateral ridges of hypopygium terminating posteriorly in a small, distinct, acute tooth; tergite 4 without an apical band of dense, appressed, pale pubescence . . . . 14.

Lateral ridges of hypopygium low, rounded off posteriorly, not terminating in a tooth or tubercle; tergite 4 with an apical band of thick, appressed pale golden pubescence . . . . *elpinice* Mickel.

14. Abdominal segments 1–5 ferruginous; median area of clypeus posterior to carina distinctly, transversely concave . . . . 15.

Only abdominal segments 1–4 ferruginous ; median area of clypeus posterior to carina not noticeably concave . . . . *sarawaka* sp. n.

15. Distal end of uncus of genitalia with a prominent hook lying between two teeth, one on the inner face and one on the outer . . . . 17.

Distal end of uncus of genitalia with a prominent hook, but with only a single tooth situated on the inner surface . . . . 16.

16. Antero-lateral areas of second tergite with moderate, close, almost contiguous punctures ; Philippines . . . . *tethys tethys* Mickel.

Antero-lateral areas of second tergite with moderate, well separated punctures ; Malay Peninsula . . . . *tethys krianae* Pagden.

17. Tooth on outer face of uncus narrow proximally, spiniform ; Amboina *tethys melanesia* subsp. n.

Tooth on outer face of uncus broad proximally, dentiform ; Borneo *tethys prodiga* subsp. n.

18. Entirely black . . . . 19.

At least the abdomen black and ferruginous . . . . 21.

19. Wings subhyaline, the proximal third very indistinctly paler than the distal two-thirds . . . . *exilis* (Smith).

Distal two-thirds of wings dark fuscous, the proximal third hyaline, the two areas contrasting strongly . . . . 20.

20. Vertex with moderate, distinct punctures ; median area of clypeus mostly glabrous, impunctate . . . . *wallacei wallacei* (Cockerell).

Vertex with moderate, dense confluent punctures ; median area of clypeus densely punctate . . . . *wallacei lalokia* subsp. n.

21. Last tergite with a narrow, median, glabrous area, the latter not tumescent, and terminating in a low tubercle . . . . 22.

Last tergite with a broad, median, tumescent, glabrous area, the latter rounded off posteriorly, not terminating in a tubercle . . . . . 30.

22. Ventral surface of posterior coxae convex, clothed only with sparse, pale pubescence . . . . 23.

Ventral surface of posterior coxae conspicuously flattened, clothed with very short, erect, dense, pale golden pubescence . . . . . *disparilis* Mickel.

23. Median area of clypeus with a distinct, median, longitudinal ridge ; tubercle on last tergite blunt, remote from the apical margin of tergite . . . 24.

Median area of clypeus transversely concave, with only a faint trace of a median, longitudinal ridge ; tubercle of last tergite small, acute, subapical . . . . *iphis* sp. n.

24. First abdominal segment very dark mahogany red to black, much darker than the second segment, sometimes the posterior third or fourth suffused with ferruginous. . . . . 25.

First abdominal segment bright ferruginous, concolorous with the second segment . . . . 26.

25. Abdominal segments 2–5 entirely ferruginous ; hypopygial ridges long, extending on to the posterior half of hypopygium *minor princesa* Mickel.

Only the second and third abdominal segments ferruginous, the remainder of abdomen black ; hypopygial ridges short, not extending on to the posterior half of hypopygium . . . . . . *minor tayabasensis* Mickel.

26. Last abdominal tergite with the area distad of the median tubercle distinctly transversely concave, the thin apical margin of the tergite strongly reflexed . . . . 27.

Last abdominal tergite with the area distad of the median tubercle practically flat, the thin apical margin of the tergite scarcely reflexed . 28.

27. Pygidial tubercle broad, transverse, almost one-fourth the width of the tergite . . . . *minor sandakanensis* subsp. n.

Pygidial tubercle narrow, subconical, about one-eighth the width of the tergite . . . . *minor islandica* Mickel.

28. Space between the ocelli and the eyes closely, distinctly punctate; pronotum with comparatively thick, appressed, pale pubescence in addition to the sparse, erect, pale pubescence . . . . 29.
Space between the ocelli and the eyes sparsely, shallowly punctate; pronotum without appressed, pale pubescence, or with very sparse, appressed, pale pubescence in addition to the sparse, erect, pale pubescence . . . . *minor visayensis* Mickel.
29. Second tergite clothed with very sparse, pale pubescence, the thin, apical fringe entirely pale . . . . *minor minor* (Ashmead).
At least the thin apical fringe, excluding the lateral sixths, dark, almost black, and the median two-thirds of the posterior fourth of the second tergite with more or less dark to black, very sparse pubescence (Cape Engano) . . . . *minor whiteheadi* Mickel.
30. Thorax conspicuously ferruginous above . . . . 31.
Thorax entirely black . . . . 32.
31. Propodeum entirely black . . . . *ianthea ianthea* (Smith).
Dorsal and posterior faces of propodeum ferruginous *ianthea rubiginosa* (André).
32. First two abdominal segments entirely ferruginous, rarely the first sternite black . . . . 33.
First abdominal segment more or less, at least the first sternite, and sometimes the anterior two-thirds of the second tergite, black or blackish . . . . 45.
33. At least abdominal segments 1–5 ferruginous . . . . 34.
At least abdominal segments 5–7 black . . . . 41.
34. Ocelli large, the distance between the inner margins of the eyes and the lateral ocelli equal to one and one-fifth times the diameter of the latter *analis* (Lepeletier).
Ocelli small, the distance between the inner margins of the eyes and the lateral ocelli equal to more than twice the diameter of the latter . . . 35.
35. Clypeus with a median, triangular elevated area, the surface of the area more or less punctate . . . . 36.
Clypeus with a median, slightly elevated area, hexagonal to subhexagonal in shape, glabrous, impunctate throughout, except a transverse, submarginal, punctate impressed line anteriorly . . . . 39.
36. Posterior coxae flattened ventrally, and produced posteriorly into a distinct, blunt tubercle, the flattened surface clothed with short, erect, dense, pale pubescence; clypeus without a median, longitudinal ridge . . . . 37.
Posterior coxae convex ventrally, not produced posteriorly, with only sparse, pale pubescence; clypeus with a median, glabrous, longitudinal ridge . . . . 38.
37. Lateral areas of second tergite with moderate, dense, confluent punctures *amans* (André).
Lateral areas of second tergite with moderately small, distinctly separated punctures . . . . *oryzae* Pagden.
38. Pronotum with sparse, appressed, pale pubescence *indagatrix indagatrix* sp. et subsp. n.
Pronotum with thick, appressed, pale pubescence *indagatrix menadoensis* subsp. n.
39. Clypeus with a median, longitudinal ridge, extending from the posterior margin anteriorly to the submarginal impressed line; abdominal segments 1–5 ferruginous . . . . 40.
Clypeus distinctly, transversely concave anteriorly, elevated along the median line only slightly on the posterior half; abdominal segments 1–6 ferruginous . . . . *concava* Mickel.

40. Second abdominal sternite evenly convex throughout; median, longitudinal ridge of clypeus inconspicuous, only slightly developed; pale pubescence of first five abdominal tergites distinctly fulvous . . . *denotata* Mickel.
Anterior third of second sternite depressed, the latter thus gibbose; median, longitudinal ridge of clypeus well developed, prominent; pubescence of first five abdominal tergites pale . . . . *cydippe* sp. n.
41. First three abdominal segments entirely ferruginous, segments 4–7 black . 42.
First four abdominal segments entirely ferruginous . . . . 44.
42. Median area of clypeus glabrous, impunctate, with a prominent, median, longitudinal ridge . . . . *boniensis* sp. n.
Median area of clypeus either punctate throughout or deeply concave . . 43.
43. Median area of clypeus deeply concave, the anterior margin very deeply emarginate medially . . . . *erato* sp. n.
Median area of clypeus convex, with moderate, close punctures throughout, with a short submarginal, transverse carina, and with the anterior margin not emarginate . . . . *novobrittanica* (Cameron).
44. Median area of clypeus for the most part glabrous, impunctate; pronotum and dorsum of propodeum with somewhat dense, appressed, pale pubescence; dorsum of propodeum with a short, transverse ridge at the apex of the enclosed space; proximal third of wings hyaline, the distal two-thirds fuscous . . . . *agapeta* (Cameron).
Median area of clypeus punctate almost throughout; pronotum and dorsum of propodeum with only sparse, erect pale pubescence; apex of enclosed area of dorsum of propodeum slightly elevated but without a distinct transverse ridge; wings entirely infuscated . . *anthylla* (Smith).
45. First and second segments of flagellum subequal in length; median area of clypeus with a low, median, longitudinal, inconspicuous ridge . . . 46.
First segment of flagellum distinctly longer than the second; median area of clypeus prominently elevated along the median line into a blunt ridge, terminating anteriorly in a prominent, submarginal, blunt tubercle . . . . 53.
46. Ocelli small, the distance between the eye-margins and the lateral ocelli equal to three or four times the greatest diameter of the latter; longitudinal clypeal ridge low, the clypeus almost flat . . . . 47.
Ocelli large, the distance between the eye-margins and the lateral ocelli equal to twice the greatest diameter of the latter; longitudinal clypeal carina high and prominent. . . . . *rhea* Mickel.
47. Pronotum clothed with black pubescence . . . . 51.
Pronotum clothed with pale pubescence . . . . 48.
48. Lateral ridges of hypopygium widely separated, the distance between the lateral margin and the tip of a lateral ridge distinctly less than half the distance between the tips of the lateral ridges . . . . 50.
Lateral ridges of hypopygium not widely separated, the distance between the lateral margin and the tip of a lateral ridge slightly greater than half, or equal to, the distance between the tips of the lateral ridges . . . 49.
49. Median, longitudinal ridge of median area of clypeus low, complete, extending to the posterior margin; distance between lateral margin of hypopygium and the tip of a lateral ridge equal to the distance between the tips of the lateral ridges, the latter strongly converging posteriorly; abdominal segments 2–6 ferruginous . . . . *pagdeni* Mickel.
Median, longitudinal ridge of median area of clypeus obsolete on posterior half, the anterior half with a prominent, median, subconical tubercle; distance between the lateral margin of hypopygium and the tip of a lateral ridge slightly greater than half the distance between the tips of the lateral ridges, the latter parallel; abdominal segments two and three ferruginous *shelfordi* sp. n.

50. Abdominal segments two and three entirely ferruginous, the remainder of abdomen black or blackish . . . . . *suspiciosa suspiciosa* (Smith).
 Abdominal segments 2–5 entirely ferruginous, only segments 1, 6 and last, black . . . . *suspiciosa discolor* Mickel.
51. Anterior two-thirds of second abdominal segment black; abdominal segments 3–6 ferruginous . . . . *fervida* (Smith).
 Second abdominal segment either entirely ferruginous, or at least the second tergite maculated with ferruginous . . . . 52.
52. Second and third abdominal segments ferruginous . *eremita eremita* Mickel.
 At least the third abdominal segment black, and usually the second broadly black along the longitudinal midline, thus the second tergite with a pair of large, lateral, ferruginous spots . . . . . *eremita umbra* Mickel.
53. Only the second abdominal segment ferruginous; tergites 3–5 sparsely clothed with intermixed fuscous and pale hairs; clypeus elevated, but the elevation not prominent . . . . 54.
 At least the second and third abdominal segments ferruginous . . . . 55.
54. Subspecies from New Guinea. . . . . *oceanica oceanica* (André).
 Subspecies from Solomon Islands . . . . *oceanica tulagiensis* subsp. n.
55. Median carina of first sternite conspicuously elevated posteriorly, the elevation broadened, strongly, transversely compressed and with the apex squarely truncate; posterior fourth of last tergite (area caudad of glabrous, tumescent area) elevated along the mid-longitudinal line, sloping to the sides, and with close, small punctures . . . . . . 56.
 Median carina of first sternite only slightly elevated posteriorly, the apex of the elevation not broadened, nor flattened, nor truncate; posterior fourth of last tergite (area caudad of glabrous, tumescent area) not sloping to the sides from an elevated mid-longitudinal line . . . . . . 57.
56. Only the second and third abdominal segments ferruginous *luzonica luzonica* (Radoskowski).
 Second, third and fourth abdominal segments ferruginous *luzonica panayensis* Mickel.
57. Posterior fourth of last tergite separated from the anterior three-fourths by a distinct, transverse depression extending the full width of the tergite; glabrous, tumescent area distinctly triangular in shape *depressula* Mickel.
 Posterior fourth of last tergite not separated from the anterior three-fourths by a depression, slightly concave and with small, sparse punctures; glabrous, tumescent area elongate, subrectangular, the sides only slightly diverging . . . . 58.
58. Pronotum with only scattered, erect, inconspicuous, pale pubescence *bakeri* Mickel.
 Pronotum with sparse, appressed, as well as scattered, erect, pale pubescence *pendleburyi* Pagden.
59. Thorax entirely or in part ferruginous . . . . 60.
 Thorax entirely black . . . . 69.
60. Pronotum and mesonotum densely, coarsely, confluently punctate; third tergite with either sparse or thick, pale pubescence . . . . 61.
 Pronotum and mesonotum with sparse, moderately small punctures; third tergite clothed mostly with sparse, black pubescence . *thoracica* (Smith).
61. All the abdominal tergites with very sparse, erect pubescence, without any appressed, pale pubescence . . . . 62.
 At least the third tergite clothed with dense, appressed, pale pubescence . 63.
62. Wings subhyaline; thorax black, except the pronotum, mesonotum, scutellum, and postscutellum ferruginous . . . . *sumatrensis* (André).
 Wings fuscous; thorax entirely ferruginous, sometimes the pleural areas darker than the notum . . . . *nedyme* sp. n.
63. Mandibles not excised beneath . . . . 64.

Mandibles distinctly excised beneath near the base . . . . 67.
64. Fourth tergite, as well as the third, with a band of thick, appressed, pale pubescence . . . . 65.
Fourth tergite black pubescent, only the third with a pale pubescent band 66.
65. Thorax almost entirely ferruginous, only the thoracic sternum black *saturnia saturnia* nom. n.
Ventral half of mesopleurae, sides and posterior face of propodeum, in addition to the thoracic sternum, all black *saturnia samawangensis* subsp. n.
66. Thorax almost entirely ferruginous, only the thoracic sternum black; abdomen dark metallic blue . . . . *rubrocyanea* sp. n.
Thorax largely black, only the pronotum, propleurae, mesonotum, scutellum, post-scutellum and tegulae ferruginous; abdomen black *bonthainensis* (André).
67. First segment of flagellum much shorter than the second . . . . . 68.
First segment of flagellum approximately equal in length to the second *rapa* (Zavattari).
68. Wings subhyaline . . . . *stella* (Zavattari).
Wings dark fuscous . . . . *hylonome* sp. n.
69. Head, thorax and abdomen entirely black . . . . 70.
At least the second abdominal segment ferruginous . . . . 77.
70. First two segments of flagellum beneath more or less marked with yellow . 71.
Flagellum entirely black . . . . 72.
71. Distal half of first flagellar segment beneath, and second flagellar segment entirely beneath, pale yellow; pubescence distinctly golden *neglecta* (Smith).
First flagellar segment beneath, and proximal half or less of second flagellar segment beneath, yellow; pubescence pale silvery *sticticornis nigridia*, Mickel.
72. Third abdominal tergite clothed entirely with dense, appressed, pale golden pubescence . . . . *gutrunae* (Zavattari).
Third abdominal tergite with only a pale pubescent band or fringe at the apical margin . . . . 73.
73. First segment of flagellum distinctly shorter than the second . . . . 74.
First segment of flagellum slightly but distinctly longer than the second . 76.
74. Median area of clypeus slightly but distinctly concave; tegulae approximately twice as long as broad; tergites 3, or 3 and 4 with appressed, pale pubescence apically, as well as erect, pale hairs . . . . 75.
Median area of clypeus bluntly elevated along the longitudinal median line, therefore convex; tegulae not more than one and one-half times as long as wide; tergites with only erect, pale hairs . . . . . . *nigerrima* Mickel.
75. Fourth abdominal tergite with only scattered, erect, pale hairs, not conspicuously pale pubescent like the third; tegulae largely testaceous *friekae friekae* (Zavattari).
Fourth abdominal tergite with thick, erect and semi-recumbent, pale pubescence like the third; tegulae blackish . . *friekae discrepans* Mickel.
76. Mesonotum with moderate, separated punctures; pubescence of body pale whitish throughout, not golden . . . . *volatilis* (Smith).
Mesonotum with moderately large, dense, confluent punctures; pubescence of body distinctly golden throughout. . . . . . . *celebensis* (André).
77. Mandibles not at all excised beneath; first segment of flagellum cylindrical, black, slightly but distinctly longer than the second . . . *spatale* sp. n.
Mandibles deeply excised beneath forming a distinct tooth beneath, near the base; first segment of flagellum usually shorter than the second, if longer, then broadened, flattened and tinged with yellow beneath . . 78.
78. Tegulae microreticulate, subopaque, feebly rugose near the margin, with scattered punctures . . . . 79.
Tegulae smooth and shining, punctate and pubescent or not . . . . 83.

79. Flagellar segments more or less pale ferruginous beneath . . . . . 80.
Antennae entirely black . . . . 82.

80. First flagellar segment cylindrical . . . . *bagrada* (Cameron).
First flagellar segment conspicuously broadened and flattened at the base 81.

81. Apex of first flagellar segment beneath, second entirely beneath, and base of third beneath, all pale ferruginous . . . . . . *nallinia* (Zavattari).
Distal half of first flagellar segment, and segments 2–4 entirely beneath, pale ferruginous . . . . *depressicornis* sp. n.

82. Mesonotum densely, moderately, confluently punctate; third abdominal segment largely black; wings fuscous . . . . . . *ira ira* (Cameron).
Mesonotum with moderate, separated punctures; third abdominal segment entirely ferruginous; wings subfuscous . . . . *ira palawana* Mickel.

83. Tegulae moderate, not extending more than one-fourth or one-fifth their length beyond the posterior margin of mesonotum . . . . 85.
Tegulae large, extending caudad of the posterior margin of the mesonotum by at least one-third their length . . . . 84.

84. Second tergite with an obscure, transverse, angular ridge separating the anterior two-thirds and posterior third; second sternite not gibbose medially on the anterior third; flagellum entirely black *olbia* (Cameron).
Second tergite with the transverse angular ridge prominent and conspicuous; second sternite strongly gibbose medially on the anterior third; first segment of flagellum obscurely yellow beneath *dercetis* sp. n.

85. Mandibles robust, heavy, broad and tridentate at the apex; clypeus depressed below the mandibles . . . . 86.
Mandibles slender, bidentate apically, *i.e.* edentate at the apex and with a small tooth within near the apex; clypeus not depressed below the mandibles, somewhat elevated along the median longitudinal line . . 88.

86. Clypeus elevated medially at the posterior margin into a prominent, acute tubercle between the antennal tubercles; abdomen except first segment entirely ferruginous . . . . *orientalis orientalis* Mickel.
Median tubercle at posterior margin of clypeus small and inconspicuous; abdomen black distally. . . . . 87.

87. Last three abdominal segments black; scutellum with only sparse, erect, pale pubescence; propodeum coarsely, deeply reticulate; second sternite with large, contiguous punctures . . . . *orientalis taiwanensis* Mickel.
Only the last tergite and last two sternites black; scutellum with appressed, pale, glittering pubescence in addition to the erect, pale pubescence; propodeum shallowly reticulate; second sternite with large, sparse punctures . . . . *kellyi* (Pagden).

88. At least the first segment of flagellum beneath, and often the proximal half of the second segment beneath, distinctly yellow; scape distinctly bicarinate beneath . . . . *sticticornis sticticornis* Mickel.
Flagellum entirely black throughout, or if the first segment tinged with yellow, then obscurely so; scape with only a single well developed carina beneath . . . . 89.

89. Tegulae punctate and pubescent throughout; second tergite with small, deep, well separated punctures . . . . *temeraria* Mickel.
At least the outer fourth of tegulae mostly impunctate, bare; second tergite with fine, sparse punctures . . . . 90.

90. Wings subhyaline; pronotum with moderate punctures, either separated or close and confluent; vertex with moderate, close punctures *fortuita fortuita* Mickel.
Wings fuscous; pronotum with moderate, dense, deep, confluent punctures; vertex with fine, sparse punctures . . . . *fortuita nebulosa* subsp. n.

♀♀.

1. Second abdominal tergite entirely black, immaculate . . . . 2.

Second abdominal tergite with at least a pair of anterior, pale pubescent spots . . . . 4.

2. Antennal tubercles and femora, ferruginous . . . . *pentheus* (Smith).

Antennal tubercles and legs, entirely black . . . . 3.

3. Tergites one, two, four and five almost entirely black pubescent *merops* (Smith).

Tergites one and two with sparse, erect, pale golden hairs in addition to the black pubescence; tergite four with pale golden pubescence, and the apical margin medially intermixed with black pubescence; tergite five with intermixed pale golden and black pubescence throughout *serafica* (Zavattari).

4. Pygidium longitudinally striate . . . . 36.

Pygidium sculptured otherwise . . . . 5.

5. Second abdominal tergite with a high, median longitudinal keel on the basal half . . . . *macassarica* (Zavattari).

Second abdominal tergite evenly convex, without any such keel . . . 6.

6. Pygidial area entirely glabrous, not sculptured; at least the coxae, trochanters and femora except the tips, ferruginous . . . . 7.

Pygidial area more or less sculptured; legs largely black . . . . . . 12.

7. Humeral angles prominently angulate; propleurae separated from pronotum by a sharp carina . . . . *mamblia* (Cameron).

Humeral angles angulate but not prominent; propleurae not separated from pronotum by a carina . . . . 8.

8. Genae with the punctures distinct . . . . 9.

Genae with moderately large, dense, confluent punctures . . *psecas* sp. n.

9. Pedicel and flagellum beneath mostly ferruginous; genae with moderately small, close, distinct punctures . . . . 10.

Pedicel and flagellum entirely black; genae with moderately large, close, deep punctures . . . . *boopis* (Kohl).

10. Second tergite with a pair of anterior, subcircular, pale pubescent spots . 11.

Second tergite with a pair of parallel lines of pale pubescence on the anterior half, the lines extending to the anterior margin *proserpina sibuyanensis* Mickel.

11. Apex of femora, and tibiae entirely, black, much darker in colour than the ferruginous femora . . . . *proserpina tibiata* Mickel.

Apex of femora, and tibiae, ferruginous, practically concolorous with the femora . . . . *proserpina proserpina* (Smith).

12. Apical margin of second tergite with a complete or incomplete narrow apical band of pale pubescence . . . . 13.

Apical margin of second tergite entirely black pubescent . . . . . . 18.

13. Narrow, apical, pale pubescent band of second tergite complete; integument beneath pale pubescence of third tergite ferruginous or black . . . . 14.

Narrow, apical, pale pubescent band of second tergite interrupted either medially or laterally; integument beneath pale pubescence of third tergite black . . . . 15.

14. Integument of third tergite beneath the pale pubescence ferruginous; pygidial area entirely granulate . . . . *circumcincta* (André).

Integument of third tergite beneath the pale pubescence, black; pygidial area delicately, longitudinally rugose on the basal half . *logei* (Zavattari).

15. Entirely black, with pale golden pubescent markings . *celebensis* (André).

At least the thorax ferruginous . . . . 16.

16. Narrow, apical, pale pubescent band of second tergite distinctly interrupted medially . . . . 17.

Narrow, apical, pale pubescent band of second tergite present medially but interrupted laterally; pygidial area very delicately rugose, mostly glabrous . . . . *pfafneri* (Zavattari).

17. Tergites three and four each with a broad band of dense, pale pubescence distinctly interrupted medially with black; femora largely ferruginous; anterior half of pygidium longitudinally rugose, the posterior half glabrous *pagdeni* Mickel.

Only tergite three with a broad band of dense, pale pubescence interrupted medially with black; tergite four black pubescent; legs entirely black; (pygidial area irregularly rugose ?) . . . . . . *dohertyi* (Zavattari).

18. Tergites three and four clothed with pale, appressed pubescence, both interrupted medially with black . . . . 19.

Tergites three and four maculated otherwise, if both three and four pale pubescent, then that on tergite three complete; if only tergite three pale pubescent, then either complete or interrupted medially . . . . . 21.

19. Pale pubescent spots of second tergite moderate in size, the distance between them approximately equal to their transverse diameter; at least the median black spot on tergite four as broad or broader than long; pale pubescent markings on tergite four not extending to lateral margins 20.

Pale pubescent spots of second tergite very large, almost reaching the anterior margin of the tergite, the distance between them approximately one-third their transverse diameter; pale pubescent bands of tergite three and four very narrowly interrupted medially by a linear spot of black pubescence two or three times as long as broad; pale pubescent markings on tergite four extending to lateral margins *repraesentoides* Mickel.

20. Pygidial area longitudinally rugose throughout; dorsal third of posterior face of propodeum weakly longitudinally sculptured; lateral margins of posterior face weakly crenulate . . . . *melmora* (Cameron).

Pygidial area irregularly rugose on basal half, transversely rugose on apical half; dorsal third of posterior face of propodeum coarsely longitudinally sculptured; lateral margins of posterior face denticulate *cameroni* (Schulz).

21. Pale pubescent band of third tergite distinctly interrupted medially; tergite four entirely black pubescent . . . . 22.

Pale pubescent band of third tergite complete; tergite four maculated with pale pubescence, or entirely black pubescent . . . . 24.

22. Pygidial area longitudinally rugose on the basal half, granulate on the posterior half . . . . *lodina* (Cameron).

Pygidial area irregularly rugose throughout . . . . 23.

23. Distance between pale pubescent spots of second tergite slightly less than twice the transverse diameter of one *vicina vicina* (Sichel & Radoskowski).

Distance between pale pubescent spots of second tergite one and one-fourth times the transverse diameter of one . . . *vicina laratensis* subsp. n.

24. Pale pubescent spots of second tergite subcircular or elongate ovate; pygidial area irregularly or longitudinally rugose . . . . 27.

Pale pubescent spots of second tergite transverse . . . . 25.

25. Pygidial area indistinctly sculptured, finely, delicately rugose *insidiator* (Smith).

Pygidial area distinctly chagreened throughout . . . . 26.

26. Pale pubescent spots of second tergite distinct and well defined *amans* (André).

Pale pubescent spots of second tergite almost obsolete . . *oryzae* Pagden.

27. Fourth abdominal tergite entirely black pubescent; legs entirely black . 28.

Fourth abdominal tergite maculated with pale pubescence . . . . . 32.

28. Pygidial area irregularly rugose throughout; longitudinal carina of first sternite entire, not emarginate . . *philippinensis philippinensis* (Smith).

Rugose sculpture of pygidium not extending to apical margin; longitudinal carina of first sternite emarginate, thus interrupted . . . . 29.

29. Vertex practically bare, clothed only with very sparse, erect, pale pubescence 30.

Vertex clothed with thick, appressed, pale pubescence . . *implicata* sp. n.

30. Basal two-thirds of pygidium longitudinally rugose, the apical third indistinctly granulate; length, 8–12 mm. . . . . 31.

Basal half of pygidium irregularly rugose, the apical half granulated; length, 5–7 mm. . . . . *manilensis* (Brown).

31. Profile of median carina on first sternite slightly sinuate *ianthea ianthea* (Smith).

Median carina of first sternite very deeply emarginate on the anterior half *ianthea rubiginosa* (André).

32. Legs entirely black . . . . 33.

Femora more or less ferruginous . . . . 35.

33. Fourth abdominal tergite with a pair of lateral spots of pale pubescence *philippinensis williamsi* Mickel.

Fourth abdominal tergite with a broad fascia of pale pubescence, very narrowly interrupted medially with black . . . . 34.

34. Pygidium longitudinally rugose throughout . . . . . , . *nereis* (Kohl).

Only anterior half of pygidium irregularly rugose, the posterior half granulate . . . . *oceanitis* sp. n.

35. Femora ferruginous, except the apices black; fourth tergite with a broad fascia of pale pubescence, interrupted medially with black *skeati* (Cameron).

Proximal two-thirds of anterior femora ferruginous, the proximal half of the middle and hind femora usually distinctly ferruginous; fourth tergite with a pair of lateral transverse spots of pale pubescence, the latter not extending to the lateral margins . . *philippinensis amartana* (Zavattari).

36. Thorax entirely black . . . . 37.

Thorax more or less ferruginous, if mostly black, at least the propleurae tinged with ferruginous . . . . 39.

37. Pale pubescent band of third abdominal tergite entire, not interrupted medially . . . . 38.

Pale pubescent band of third abdominal tergite distinctly interrupted medially with black . . . . *wallacei wallacei* (Cockerell).

38. Legs black . . . . *albertisi* (André).

Legs ferruginous . . . . *doricha* (Smith).

39. Thorax entirely ferruginous . . . . 41.

Thorax more or less black, at least the venter black . . . . 40.

40. Femora tinged with ferruginous; New Guinea. . *oceanica oceanica* (André).

Legs entirely black; Solomon Islands . . . *oceanica tulagiensis* subsp. n.

41. Fourth tergite entirely black pubescent; third tergite with either an entire or interrupted band of pale pubescence . . . . 44.

Fourth tergite with a broad band of dense, pale pubescence, distinctly interrupted medially with black . . . . 42.

42. Coxae and antennal tubercles ferruginous; humeral angles rounded; thorax not broader posteriorly than anteriorly . . . . *repraesentans* (Smith).

Coxae and antennal tubercles black; humeral angles distinctly angulate; thorax distinctly broader posteriorly than anteriorly . . . . 43.

43. Pale pubescent band of third tergite complete, not interrupted medially *taihorina taihorina* Mickel.

Pale pubescent band of third tergite distinctly interrupted medially like the fourth . . . . *taihorina nipponica* subsp. n.

44. Pale pubescent band of third tergite complete, not emarginate nor interrupted medially . . . . 47.

Pale pubescent band of third tergite distinctly interrupted medially, or almost interrupted by a median, anterior, triangular emargination . . 45.

45. Mesonotal region slightly but noticeably narrowed; pubescent band of third tergite interrupted medially . . . . *fervida* (Smith).
Mesonotal region not noticeably narrowed, the sides of the thorax parallel; pubescent band of third tergite interrupted or emarginate . . . . . 46.

46. Pale pubescent band of third tergite distinctly interrupted medially with black . . . . *eremita umbra* Mickel.
Pale pubescent band of third tergite almost interrupted by an anterior, median, triangular emargination . . . . *eremita eremita* Mickel.

47. Second tergite with a distinct, narrow, apical band of pale pubescence at the apical margin, interrupted medially with black . . *minae* (Zavattari).
Second tergite with the apical margin entirely black pubescent, except sometimes with a few scattered, erect, pale hairs . . . . 48.

48. Anterior pair of pale pubescent spots of second tergite small, subcircular . 50.
Anterior pair of pale pubescent spots of second tergite large, elongate, about twice as long as broad . . . . 49.

49. Pubescent markings of abdomen pale silvery; distance between pubescent spots of second tergite one and one-half times their greatest diameter; pygidium striate only on anterior half . . . . *ovatula ovatula* Mickel.
Pubescent markings of abdomen distinctly golden; distance between pubescent spots of second tergite about equal to their transverse diameter; pygidial striae extending almost to posterior margin *ovatula aurifera* Mickel.

50. Second tergite distinctly gibbose between and slightly anterior to the pale pubescent spots . . . . 51.
Second tergite evenly convex throughout, not at all gibbose; apical half of pygidium granulate . . . . 52.

51. Vertex densely punctate and longitudinally ridged . . *pendleburyi* Pagden.
Vertex densely punctate but not longitudinally ridged . . *sibylla* (Smith).

52. Apical margin of second tergite with a thin, apical fringe of pale pubescence; pygidial striae reaching or almost reaching the posterior margin of the pygidium . . . . *minor minor* (Ashmead).
Apical margin of second tergite entirely black pubescent, except the lateral extremes; pygidial striae usually not extending on to the posterior third of pygidium . . . . 53.

53. Tayabas area, Philippine Islands . . . . . *minor tayabasensis* Mickel.
Visayan area, Philippine Islands. . . . . *minor visayensis* Mickel.
Mindanao area, Philippine Islands . . . . . . *minor islandica* Mickel.
Borneo . . . . *minor sandakanensis* subsp. n.

Timulla (*Trogaspidia*) *philippinensis philippinensis* (Smith).

Mutilla philippinensis Smith, 1855, *Cat. Hymen. Brit. Mus.*, **3** : 40, ♀.
Mutilla accedens Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 227–228, ♀.
Mutilla dimidiata Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 285–286, ♂ (in part; Luzon specimens).
Mutilla suspiciosa Bingham, 1895, *Ann. Mag. nat. Hist.*, (6) **16** : 440–441, ♀ and ♂ (in part) (*nec* Smith).
Mutilla philippinensis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 73, ♀.
Mutilla accedens André, 1899, *Ann. Soc. ent. Fr.*, **68** : 32, ♀.
Mutilla philippinensis André, 1903, *Gen. Insect.*, **11** : 40, ♀.
Mutilla philippinensis Ashmead, 1904, *Proc. U.S. Nat. Mus.*, **28** : 152, ♀.
Trogaspidia bicolor Ashmead, 1905, *Proc. U.S. Nat. Mus.*, **28** : 962, ♂.
Mutilla accedens Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♀.
Mutilla philippinensis Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♀.
Mutilla suspiciosa Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂ and ♀.
Trogaspidia bicolor Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
Mutilla dimidiata Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
?*Mutilla ianthea* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 75, ♀ (in part; Manila specimen).
Trogaspidia bicolor Cockerell, 1927, *Philipp. J. Sci.*, **33** : 277, ♂.

Trogaspidia dimidiata Cockerell, 1927, *Philipp. J. Sci.*, **33** : 277, ♂.
Timulla (*Trogaspidia*) *philippinensis philippinensis* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 395, ♂ and ♀.
Timulla (*Trogaspidia*) *philippinensis philippinensis* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 147, ♂ and ♀.

Holotype.—♀, PHILIPPINE ISLANDS, in British Museum (Natural History). The type of *bicolor*, the ♂, is in the U.S. National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Luzon, Polillo, Cebu, Negros, Panay, Mindanao and Palawan.

The specimen from Amboina recorded by André (1896) is evidently not the same as this species.

Timulla (*Trogaspidia*) *philippinensis williamsi* Mickel.

Timulla (*Trogaspidia*) *philippinensis williamsi* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 149, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Los Banos, Luzon, March, 1917 (*F. X. Williams*), in University of Minnesota collection.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *philippinensis itambusa* (Cockerell).

Trogaspidia itambusa Cockerell, 1927, *Philipp. J. Sci.*, **33** : 275–277, ♂.
Timulla (*Trogaspidia*) *philippinensis itambusa* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 150, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Lucban, Tayabas province, Luzon, May, 1926 (*McGregor*), in U.S. National Museum.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *philippinensis amartana* (Zavattari).

Mutilla amartana Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 28, ♀ and ♂.
Mutilla amartana Esaki et alii, 1932, *Icon. Insect. Jap.* : 327, ♀ and ♂.
Timulla (*Trogaspidia*) *philippinensis amartana* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 391, ♀ and ♂.

Lectotype.—♀, FORMOSA : Taihauroku, August 3–10, 1908 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Allotype.—♂, FORMOSA : Taihauroku, August 3–10, 1908 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

The specimens recorded by Zavattari (1913) from various localities other than Formosa have not been examined but undoubtedly are not conspecific with the Formosa form.

Timulla (Trogaspidia) philippinensis sunda subsp. n.

♂. Very close to subsp. *amartana* Zavattari; differs in having the disk of the second tergite almost entirely glabrous, impunctate, with only a very few, scattered punctures; apical fringe of sixth abdominal tergite black; colour and pubescence as in *amartana* except the dorsum of propodeum with the pale pubescence more sparse. Length, 21 mm.

Holotype.—♂, JAVA : (*Soekaboemi*), in Cornell University collection, Ithaca, New York.

Paratype.—♂, JAVA : (*Soekaboemi*).

Timulla (Trogaspidia) philippinensis singapora subsp. n.

♂. Black, except abdominal segments two, three and four, ferruginous; pronotum with dense, appressed, pale pubescence as in *amartana* and *malayana*; front and dorsum of propodeum with sparse, appressed, pale pubescence; clypeus elevated along the median, longitudinal line forming a dull, prominent carina, much more prominent than in any other described subspecies of *philippinensis*; disk of second tergite largely glabrous, impunctate, with only a few scattered punctures; fifth tergite tinged with ferruginous anteriorly; otherwise sculptured as in *amartana*.

Holotype.—♂, Malaya: Singapore, Straits Settlements (*Baker*), Cat. no. 50037 United States National Museum.

Timulla (*Trogaspidia*) *philippinensis malayana* (Cameron).

Mutilla malayana Cameron, 1901, *Proc. zool. Soc. Lond.*, **1901** (2) : 16, ♂.
——— *malayana* André, 1903, *Gen. Insect.*, **11** : 71, ♂.
Timulla (*Trogaspidia*) *philippinensis malayana* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 395, ♂ (*nec* ♀).

Holotype.—♂, Malay Peninsula: Bukit Besar, Jalor (District of Patani State), in British Museum (Natural History).

Distribution.—Known only from the type locality.

It is probable that this subspecies occurs only in the eastern portion of the Malay Peninsula. Specimens from other parts of Malaya should be compared with the type as to clypeal structure and other sculptural characters before being recorded as this subspecies.

Timulla (*Trogaspidia*) *skeati* (Cameron).

Mutilla skeati Cameron, 1901, *Proc. zool. Soc. Lond.*, **1901** (2) : 17, ♀.
Mutilla skeati André, 1903, *Gen. Insect.*, **11** : 41, ♀.
Timulla (*Trogaspidia*) *philippinensis malayana* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 395, ♀ (*nec* ♂).

Holotype.—♀, Malay Peninsula: Kuala Aring, State of Kelantan, in British Museum (Natural History).

Distribution.—Known only from the type locality.

This species is closely related to *philippinensis philippinensis*, and is probably the female of *malayana* Cameron. I (1933) went so far as to place *skeati* as a synonym of *malayana*, but since there are other subspecies of males, i.e. *sunda* and *singapora*, known from the Malay Peninsula, and others may still be undescribed, it appears to me best to retain the name *skeati* until the correlation of the sexes can be established by definite biological evidence.

Timulla (*Trogaspidia*) *exilis* (Smith).

Mutilla exilis Smith, 1859, *J. Proc. linn. Soc., Zool.*, **3** : 151, ♂.
Mutilla exilis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 39, ♂.
Mutilla exilis André, 1903, *Gen. Insect.*, **11** : 39, ♂.

Holotype.—♂, Kei Island, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

Related to the following species *wallacei*, but the wings are subhyaline with almost no contrast between the proximal and distal areas of the wing. There are also differences in the form of the clypeus and in puncturation. The specimen recorded by Zavattari (1913) from Amboina is probably a new subspecies of *wallacei*, since Zavattari describes the base of the wings as hyaline and the remainder with violet reflections.

The type specimen labelled in Smith's handwriting bears a locality label, "Kei," and not Aru as stated in the description.

Timulla (*Trogaspidia*) *wallacei wallacei* (Cockerell).

Mutilla nigra Smith, 1859, *J. Proc. linn. Soc., Zool.*, **3** : 151, ♂ (*nec* Rossi).
Mutilla nigra André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 78, ♂ (*nec* Rossi).
Mutilla nigra Dalle Torre, 1897, *Cat. Hymen.*, **8** : 66, ♂ (*nec* Rossi).
Mutilla nigra André, 1898, *Ann. Soc. ent. Fr.*, **67** : 27, ♂ and ♀ (*nec* Rossi).
?*Mutilla nigra* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 583, ♂ (*nec* Rossi).
Mutilla wallacei Cockerell, 1907, *Entomologist*, **40** : 50, ♂.
?*Mutilla nigra* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 83, ♂ and ♀ (*nec* Rossi).

Holotype.—♂, ARU ISLAND, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—ARU ISLAND; NEW GUINEA : Geelvink Bay.

I have examined the males from Geelvink Bay, New Guinea, described by André (1898) and which were taken with the females attributed to this species. I did not have an opportunity to compare these specimens directly with Smith's type, but apparently they are the same as an Aru specimen which has been compared with the type. I have not been able to examine the specimens recorded from New Guinea by Mantero (1900) and Zavattari (1913).

Timulla (Trogaspidia) wallacei lalokia subsp. n.

♂. Entirely black like subsp. *wallacei* with the proximal third of the wings hyaline and the distal two-thirds fuscous with violet reflections; first segment of flagellum compressed and slightly longer than the second as in subsp. *wallacei*; differs in having the clypeus densely punctate except a low, glabrous gibbosity posteriorly; vertex with moderate, dense, confluent punctures; mesonotum with moderately large, close, more or less confluent punctures (in subsp. *wallacei* the mesonotal punctures moderate and distinct); second abdominal segment slightly tinged with ferruginous.

Holotype.—♂, PAPUA : Laloki, 1910 (*F. Muir*), in University of Minnesota collection.

Paratype.—♂ PAPUA : Laloki.

Timulla (*Trogaspidia*) *doricha* (Smith).

Mutilla doricha Smith, 1860, *J. Proc. linn. Soc., Zool.*, **5** : 116, ♀.
Mutilla doricha Dalle Torre, 1897, *Cat. Hymen.*, **8** : 32, ♀.
Mutilla doricha André, 1903, *Gen. Insect.*, **11** : 39, ♀.

Holotype.—♀, NEW GUINEA : Dory, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *albertisi* (André).

Mutilla albertisi André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 70, ♀.
Mutilla albertisi Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 582, ♀.
Mutilla albertisi André, 1903, *Gen. Insect.*, **11** : 38, ♀.

Holotype.—♀, NEW GUINEA : Fly River, in Museo Civico di Storia naturale, Genoa.

Distribution.—NEW GUINEA.

Timulla (*Trogaspidia*) *oceanica oceanica* (André).

Mutilla oceanica André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 73, ♀ and ♂.
Mutilla oceanica Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 582, ♀ and ♂ (in part).
Mutilla oceanica André, 1903, *Gen. Insect.*, **11** : 40, ♀ and ♂.
Mutilla oceanica Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 84, ♀ and ♂.

Holotype.—♀, NEW GUINEA, in Museo Civico di Storia naturale, Genoa.

Allotype.—♂, NEW GUINEA, in Museo Civico di Storia naturale, Genoa.

Distribution.—New Guinea.

Specimens of this subspecies have been recorded from the Solomon Islands by André in the original description. It is certain that the Solomon Island specimens are representatives of the following subspecies.

Timulla (Trogaspidia) oceanica tulagiensis subsp. n.

♀. Differs from subsp. *oceanica* in being entirely black, except the antennal tubercles and propleurae faintly tinged with ferruginous; second tergite with a pair of elongate, ovate spots situated anteriorly, the third tergite with a pair of subrectangular spots, all of dense, pale, glittering pubescence; pygidium longitudinally striate on the anterior two-thirds, the distal third granulate. Length, 9·5 mm.

♂. Similar to the male of subsp. *oceanica.*

Holotype.—♀, Solomon Islands : Tulagi, July 2, 1933, on *Hibiscus* (*H. T. Pagden*), in University of Minnesota collection.

Allotype.—♂, Solomon Islands : Tulagi, August 13, 1933 (*H. T. Pagden*), in University of Minnesota collection.

Paratypes.—Solomon Islands : Tulagi, 19 ♂♂, 3.vii.1933–23.xi.1933; 1 ♀, 6.viii.1933; 1 ♂, Emu Harbor, Ganonga Is., 29.v.1934; 1 ♂, Lambu Lambu, Vella Lavella Is., 31.v.1934; 1 ♂, Jack Harbor, Kolombangara Is., 6.vi.1934; ♂ and ♀ *in copula*, Jack Harbor, Kolombangara Is., 7.vi.1934; ♂ and ♀ *in copula*, Gizo, Gizo Is., 4.vi.1934; ♂ and ♀ *in copula*, nr. Reko, Savo Is., 24.ii.1934; ♂ and ♀ *in copula*, Lavoro, Guadalcanal Is., 20.ii.1934; ♂ and ♀ *in copula*, Lavoro, Guadalcanal Is., 17.iv.1934; ♂ and ♀ *in copula*, Hylaba, Guadalcanal Is., 19.ii.1934 (all *H. T. Pagden*).

The colour of the thorax of the females varies from almost entirely black, with only the propleura ferruginous, to largely ferruginous with only the venter black and with a fuscous to black spot on the median ventral part of the pleurae. The colour of the second and third abdominal segments of the male varies from almost entirely black with a small, ferruginous spot on the disk of the second tergite, to entirely ferruginous. I have not had specimens of subsp. *oceanica* André from New Guinea to compare with these specimens from the Solomon Islands, so am unable to point out any definite morphological characters which may be used to separate the two subspecies. It is probable that a study will show differences in the genitalia of the two males and some difference in the females which cannot be ascertained from André's description.

Timulla (*Trogaspidia*) *minor minor* (Ashmead).

Mutilla vicina Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 228, ♀ (in part; Luzon specimen).
Mutilla analis Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 284–285, ♂ (in part; Luzon specimen).
Trogaspidia minor Ashmead, 1905, *Proc. U.S. Nat. Mus.*, **28** : 963, ♂.
Mutilla analis Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
Trogaspidia minor Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
Mutilla browni Rohwer, 1910, *Proc. U.S. Nat. Mus.*, **37** : 658. ♀.
Mutilla sp. Williams, 1919, *Bull. Hawaii. Sugar Pl. Exp. Sta.* (*Ent.*), **14** : 63, ♀.
Timulla (*Trogaspidia*) *minor minor* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 150, pl. 1, fig. 3, ♀ and ♂.

Holotype.—♂, Philippine Islands : Manila, Luzon, in United States National Museum. The holotype of *browni* Rohwer is also in the United States National Museum.

Distribution.—Philippine Islands : Island of Luzon.

Timulla (*Trogaspidia*) *minor whiteheadi* Mickel.

Mutilla suspiciosa Bingham, 1895, *Ann. Mag. nat. Hist.*, (6) **16** : 440–441, ♂ (in part) (*nec* Smith).
Timulla (*Trogaspidia*) *minor whiteheadi* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 152, pl. 1, fig. 4, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Cape Engano, Luzon Island, in British Museum (Natural History).

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *minor tayabasensis* Mickel.

Timulla (*Trogaspidia*) *minor tayabasensis* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 152, pl. 1, fig. 5, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Polillo Island (*Baker*), in United States National Museum.

Allotype.—♀, PHILIPPINE ISLANDS : Polillo Island (*Baker*), taken *in coitu* with holotype ♂, in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : Polillo Island and Tayabas Province, Luzon Island.

Timulla (*Trogaspidia*) *minor visayensis* Mickel.

Trogaspidia minor Lopez, 1931, *Ann. Rep. Res. Dept., Philipp. Sugar Ass.*, **1930–31** : 246–247, pl. 7, fig. 3, ♂.
Trogaspidia browni Lopez, 1931, *Ann. Rep. Res. Dept., Philipp. Sugar Ass.*, **1930–31** : 247, ♀.
Timulla (*Trogaspidia*) *minor visayensis* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 153, pl. 1, fig. 6, ♂ and ♀.

Holotype.—♂, PHILIPPINE ISLANDS : N.W. Panay Island (*Baker*), in United States National Museum.

Allotype.—♀, PHILIPPINE ISLANDS : N.W. Panay Island (*Baker*), taken *in coitu* with holotype ♂; in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Panay, Batbatan, Sibuyan, Negros and Cebu.

Timulla (*Trogaspidia*) *minor islandica* Mickel.

Timulla (*Trogaspidia*) *minor islandica* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 155, pl. 1, fig. 7, ♂ and ♀.

Holotype.—♂, PHILIPPINE ISLANDS : Surigao, Mindanao (*Baker*), in United States National Museum.

Allotype.—♀, PHILIPPINE ISLANDS : Surigao, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Samar, Biliran, Mindanao and Basilan.

Timulla (*Trogaspidia*) *minor princesa* Mickel.

Timulla (*Trogaspidia*) *minor princesa* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 156, pl. 1, fig. 8, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Port Princesa, Palawan Island (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Timulla (Trogaspidia) minor sandakanensis subsp. n.

♂. Head, thorax and legs black, the abdomen ferruginous, except the last two segments, black; pronotum with sparse, erect and appressed, pale pubescence; median carina of clypeus forming a dull ridge; last tergite with the tubercle very broad, about one-fourth the width of the tergite, the latter transversely concave beyond the tubercle. Length, 12 mm.

♀. Head, abdomen and legs, black, the thorax entirely ferruginous; pale pubescent spots on tergite two small, circular, separated by about twice their diameter; pale pubescent band of tergite three entire; pygidial area longitudinally striate, the striae not extending on to the posterior fourth of pygidium, the posterior fourth granulate.

Holotype.—♂, North Borneo: Kudat, September 13, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Allotype.—♀, North Borneo: Kudat, September 13, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History). ♀ taken while being carried by holotype ♂.

Paratypes.—North Borneo: Kudat, 16 ♂♂, 1.ix.1927–18.ix.1927 (all *C. B. K.* and *H. M. P.*); Kudat, 1 ♂ and 1 ♀, 2.ix.1927 (*C. B. K.* and *H. M. P.*); Samawang, near Sandakan, ♂, 15.vii.1927 (*C. B. K.* and *H. M. P.*); Labuan Islands, 4 ♂♂, 23.ix.1927 (*C. B. K.* and *H. M. P.*); Sandakan, 9 ♂♂, 11 ♀♀ (*Baker*).

The male is easily distinguished from the other subspecies of *minor* by the extreme transverse development of the tubercle on the last tergite; the tubercle is equal in breadth to one-fourth the width of the tergite, the latter beyond the tubercle transversely concave, glabrous, thus the tubercle conspicuous. The female is indistinguishable from the subsp. *islandica* and can only be recognised on geographical grounds.

Timulla (*Trogaspidia*) *disparilis* Mickel.

Mutilla analis Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 41, ♂ (in part) (*nec* Lepeletier).
Timulla (*Trogaspidia*) *disparilis* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 398, ♂.
Timulla (*Trogaspidia*) *disparilis* Mickel, 1933, *Lingnan Sci. J.*, **12** : 314, ♂.

Holotype.—♂, Formosa: Taihorin, June, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Hainan Island, Formosa, and Japan.

Specimens examined.—3 ♂♂, Japan (*F. Muir*).

I have compared the Japanese and Hainan Island specimens with the Formosa holotype and am unable to find any differences whatever. The genitalia are the same in all three. An important character not mentioned in the original description concerns the posterior coxae; the ventral surface of the latter are distinctly flattened and clothed with very short, dense, erect, pale golden pubescence.

Timulla (Trogaspidia) iphis sp. n.

♂. Head, thorax, last abdominal segment, and legs, black; first six abdominal segments ferruginous, except the sixth posteriorly tinged with black; median area of clypeus transversely concave, with only a faint indication of a median, longitudinal ridge; first segment of flagellum slightly shorter than the second when seen from beneath; last tergite with a very narrow, glabrous, longitudinal ridge terminating subapically in a small, low, acute tubercle. Wings subfuscous. Length, 8 mm. *Head* entirely black, clothed throughout with sparse, erect, pale pubescence, except the front medially with thick, appressed, pale pubescence; mandibles moderately slender, excised near the base beneath forming a distinct tooth, edentate at the apex and with a small tooth within near the apex; clypeus as described above, the median area glabrous, impunctate; scape distinctly bicarinate beneath; first segment of flagellum slightly shorter than the second when viewed from beneath; antennal scrobes carinate above; front, vertex and genae with moderate, shallow, dense, confluent punctures; relative widths of head and thorax at the tegulae, 2·9–3·3. *Thorax* entirely black, the mesonotum and anterior half of scutellum with sparse, black pubescence, the pronotum and mesopleurae with thick, appressed, pale pubescence, elsewhere with sparse, pale pubescence somewhat thicker on the dorsum of propodeum; pronotum, mesonotum and scutellum with moderate, shallow, close, confluent punctures; parapsidal furrows distinct on posterior two-thirds of mesonotum; dorsum and posterior face of propodeum rounded into one another, distinctly, broadly reticulate; enclosed space of dorsum of propodeum about two and one-half times as long as broad anteriorly, the posterior two-thirds slightly narrowed; anterior margin of propleurae defined by a carina, the propleurae micropunctate as well as with scattered, obscure, moderate punctures; ventral and dorsal areas of mesopleurae elevated, the two separated by a distinct furrow; mesopleurae with moderate, dense, confluent punctures, except the anterior third micropunctate; metapleurae micropunctate and pale micropubescent with a few moderate punctures ventrally; posterior third of sides of propodeum shallowly reticulate, the remainder micropunctate; tegulae glabrous, impunctate, except the inner and anterior margins punctate and black pubescent. *Abdomen* ferruginous, except the last segment black, and the posterior third of the sixth tergite tinged with black, clothed throughout with sparse, pale pubescence, except the posterior third of the sixth tergite and the anterior half of the last tergite with sparse, blackish pubescence; first tergite with moderate, shallow, scattered punctures; second tergite with the disk glabrous, impunctate, with moderate, distinct punctures elsewhere, sparse anteriorly, less than their own diameter apart on the lateral thirds; tergites three to six with sparse, small punctures; last tergite with a very narrow, median, longitudinal, glabrous ridge terminating subapically in a small, acute, low tubercle, the lateral areas with small, close punctures; first sternite with a distinct, median, longitudinal carina on the anterior two-thirds; second sternite with moderate, distinct, sparse punctures; sternites three to six with small, sparse punctures posteriorly; seventh sternite with a pair of low, extreme lateral, longitudinal, inconspicuous ridges; hypopygium with a pair of lateral, longitudinal, glabrous, parallel ridges terminating posteriorly in a slender, very acute tubercle; hypopygium closely punctate. Basal third of *wings* hyaline, the distal two-thirds subfuscous; cell 2nd $R_1 + R_2$ narrowly truncate at the apex, equal in length to cell $R +$ 1st R_1; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 almost obsolete, receiving the almost obsolete vein M_2 at three-fourths the distance from base to apex; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Java: Pekalongan, April, 1907 (*F. Muir*), in University of Minnesota collection.

Very distinct from other Java males; the form of clypeus, last abdominal tergite, almost entirely ferruginous abdomen, and small size will aid in identifying this species.

Timulla (*Trogaspidia*) *analis* (Lepeletier).

Mutilla analis Lepeletier, 1845, *Hist. nat. Ins., Hymen.*, **3** : 360, ♂.
Timulla (*Trogaspidia*) *analis* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 402, ♂.

Holotype.—♂, Indo-orientalis, in Spinola collection, University of Torino, Turin.

Distribution.—Known only from India.

I include this species in the key and give a redescription of the type because it has been often misidentified and reported incorrectly from Formosa, Philippine Islands, and other of the Pacific Islands. I have seen no specimens from any of the islands of the Pacific that are the same as Lepeletier's type. The redescription of the holotype in the Spinola collection follows :

Head, thorax, last abdominal segment, and legs black; remainder of abdomen ferruginous, the first tergite very dark ferruginous anteriorly. *Head* clothed throughout with pale pubescence, thickest on the front; mandibles slender, bidentate at the apex, strongly excised beneath near the base; clypeus almost flat, but with an obscure, median, longitudinal raised line, the latter terminating shortly posterior to the anterior margin; anterior and lateral margins of clypeus with a few, moderate, shallow punctures; scape distinctly bicarinate beneath; first segment of flagellum about equal in length to the second; front with moderately small, sparse punctures; vertex laterally with obscure shallow punctures, medially with moderate, close punctures; genae with moderately small, close punctures; ocelli large, the distance between the lateral ocelli and the inner margins of the eyes equal to one and one-fifth times the greatest diameter of the latter. *Pronotum* with large, confluent punctures, sparsely clothed with intermixed pale and fuscous pubescence; mesonotum with moderately large, close punctures and sparse, black pubescence; scutellum elevated medially into a blunt tubercle, the latter impunctate, otherwise with moderate, dense punctures; dorsum of propodeum with a very long median enclosed space only slightly elevated apically, the dorsum and posterior face rounded into one another and broadly reticulate; sides of propodeum distinctly reticulate; tegulae glabrous, impunctate, except anterior and inner margins punctate and black pubescent. *Abdomen* clothed above and beneath with golden ferruginous pubescence, except the last segment with black pubescence; second tergite glabrous, almost impunctate on the disk, with moderately small, shallow punctures towards the sides; last tergite with a median, longitudinal, impunctate area on the anterior half, the apex of this area rounded off into a broader impunctate area on the posterior half, not at all tuberculate; sixth sternite without lateral tubercles; seventh sternite with very small, obscure tubercles at the postero-lateral angles; hypopygium with a pair of strongly elevated, sharp ridges on the anterior half, converging towards the rear. *Wings* subfuscous; cell R + 1st R_1 about equal in length to cell 2nd $R_1 + R_2$, the latter narrowly truncate at the apex; distance between base of stigma and origin of vein m equal to the length of the stigma; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex.

Timulla (*Trogaspidia*) *amans* (André).

Mutilla amans André, 1909, *Notes Leyden Mus.*, **31** : 173, ♀ and ♂.

Lectotype.—♀, JAVA: Tandjong-Priok, April, 1908 (*M. E. Jacobson*), in Leyden Museum.

Allotype.—♂, JAVA: Tandjong-Priok, April, 1908 (*M. E. Jacobson*), in Leyden Museum.

Specimens examined.—♀, JAVA: Pekalongan, April, 1907 (*F. Muir*); 3 ♂♂, Pekalongan (*F. Muir*).

Distribution.—JAVA.

I have not had an opportunity to examine the lectotype and allotype specimens, but have seen the male and female from Batavia mentioned by André, and one of the female specimens from Mulie, Java. All of these specimens agree with André's description.

Timulla (*Trogaspidia*) *oryzae* Pagden.

Timulla (*Trogaspidia*) *oryzae* Pagden, 1934, *J. F.M.S. Mus.*, **17** : 426–433, figs. 3–6, ♂ and ♀.

Holotype and Allotype.—♂ and ♀ (*in copula*), FEDERATED MALAY STATES: Simpang Lima, Alor Pongsu, Krian, Perak, May 20, 1930, in British Museum (Natural History).

Distribution.—FEDERATED MALAY STATES.

I have examined paratypes of this species and find it to be closely related to *amans* André. The differences between the two species are indicated in the keys.

Timulla (Trogaspidia) indagatrix indagatrix sp. et subsp. n.

♂. Head, thorax, legs and last two abdominal segments black, the remainder of the abdomen entirely ferruginous; median area of clypeus triangular, punctate and pale pubescent, except a median, longitudinal, glabrous ridge; ocelli moderately large, the distance between the eye-margins and a lateral ocellus two and one-fourth times the diameter of the latter; pronotum clothed with sparse, appressed, pale pubescence; last tergite with a broad, median, tumescent, glabrous area rounded off posteriorly; posterior coxae convex, sparsely clothed with pale pubescence. Wings subfuscous. Length, 13 mm. *Head* entirely black, the clypeus except medially, and lower inner eye-margins broadly, with dense, appressed, pale pubescence, the front with sparse, appressed, pale pubescence, the remainder with sparse, erect, pale pubescence; mandibles moderately robust, tinged with ferruginous medially, excised beneath near the base forming a tooth, edentate at the apex and with a distinct tooth within near the apex; median triangular area of clypeus elevated, punctate and pubescent throughout, except a median, longitudinal, glabrous ridge not extending to the anterior margin; scape distinctly bicarinate beneath; first segment of flagellum slightly longer than the second; antennal scrobes carinate above; front and vertex with moderately large, close, confluent punctures, the genae with moderate, confluent punctures; relative widths of head and thorax at the tegulae, 5·1–5·9. *Thorax* entirely black, the mesonotum and anterior half of scutellum with sparse, erect, black pubescence, the pronotum with sparse, appressed, pale pubescence, the mesopleurae with dense, appressed, pale pubescence, and elsewhere, with sparse, erect, pale pubescence; pronotum, mesonotum and scutellum with large punctures, dense and confluent on pronotum, close and somewhat confluent on mesonotum, dense, deep and confluent on scutellum; dorsum and posterior face of propodeum rounded into one another, broadly reticulate; enclosed space of dorsum of propodeum elongate, subtriangular, the sides sinuate and with a median, longitudinal raised line; anterior margin of propleurae defined by an obscure carina, the propleurae longitudinally rugose; ventral and dorsal areas of mesopleurae moderately elevated, the two separated by a shallow furrow, with moderately large, dense, confluent punctures, except anteriorly micropunctate; metapleurae micropunctate and pale micropubescent, with moderate, shallow punctures ventrally; sides of propodeum shallowly reticulate on posterior two-thirds, the remainder micropunctate; tegulae glabrous, impunctate, except the anterior and inner margins punctate and with pale pubescence. *Abdomen* ferruginous, except the last two segments black, clothed with sparse, pale pubescence, except the last two tergites with sparse, black pubescence; first tergite with moderate, scattered punctures and posteriorly with small, close, submarginal punctures; disk of second tergite with scattered, moderately small punctures, the latter becoming closer and almost confluent antero-laterally, smaller and sparse posteriorly; tergites three to six with small, sparse punctures; last tergite with a median, elongate, tumescent, glabrous area rounded off posteriorly, laterad of glabrous area with small to moderate, dense punctures; first sternite with a median, longitudinal carina, elevated posteriorly into a small, distinct tooth; second sternite with moderate, sparse punctures; sternites three to six with small, close punctures posteriorly; seventh tergite with a pair of small postero-lateral tubercles; hypopygium with a pair of lateral, longitudinal, glabrous ridges, slightly converging posteriorly, terminating in a distinct, posteriorly directed, acute tubercle, otherwise with small, close punctures. *Wings* subfuscous, slightly paler on the proximal third; cell 2nd $R_1 + R_2$ truncate at the apex, equal in length to cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at three-fifths the distance from base to apex; cell R_4 almost obsolete, receiving the almost obsolete vein M_2 at three-fifths the distance from base to apex; vein *m-cu* terminating only slightly anterior of vein $M_4 + Cu_1$. *Legs* entirely black, sparsely clothed with pale pubescence; ventral surface of posterior coxae convex; calcaria pale.

Holotype.—♂, AMBOINA (*F. Muir*), in University of Minnesota collection.
Paratypes.—6 ♂♂, AMBOINA (*F. Muir*).

The punctate clypeus with median, glabrous ridge, somewhat large ocelli, and mostly ferruginous abdomen are characteristic of this species.

Timulla (Trogaspidia) indagatrix menadoensis subsp. n.

♂. Exactly like subsp. *indagatrix* from Amboina except the pronotum with thick, appressed, pale pubescence.

Holotype.—♂, CELEBES: Gorontalo, May 10–12, 1905 (*R. Shelford*), in Hope Dept. Oxford University.
Paratype.—♂, CELEBES: Gorontalo, May 10–12, 1905 (*R. Shelford*).

Timulla (Trogaspidia) implicata sp. n.

♀. Head, abdomen and legs, entirely black, the thorax entirely ferruginous; vertex clothed with thick, appressed, pale pubescence; second tergite with a pair of anterior, pale pubescent spots, the latter separated by about their own diameter; third tergite clothed throughout with dense, appressed, pale pubescence; pygidial area irregularly rugose on the anterior two-thirds, granulate on the apical third. Length, 7 mm. *Head* entirely black, except the mandibles medially and the antennal tubercles ferruginous, the front clothed with sparse, fuscous pubescence, the vertex with thick, appressed, pale pubescence, and the genae with sparse, erect, pale pubescence; mandibles slender, edentate at the apex and with a small tooth within near the apex; clypeus elevated posteriorly, the elevated margin arcuate, and a median, small tubercle just posterior to the elevated margin; scape with small punctures; first segment of flagellum one and one-half times as long as the second; antennal scrobes carinate above; front, vertex and genae with moderate, dense, confluent punctures; relative widths of head and thorax, 3·3–2·8. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect and recumbent, dark ferruginous pubescence, the posterior face of propodeum with sparse, long, erect, pale pubescence, and the pleural areas with pale micropubescence; dorsum with moderately large, dense, confluent punctures; humeral angles angulate but inconspicuous; pronotum slightly wider posteriorly than anteriorly; mesonotum only faintly narrower than the pronotum, the lateral margins parallel and crenulate; scutellar scale present and distinct; dorsum of propodeum and anterior fourth of posterior face with sparse, small punctures; lateral margins of posterior face of propodeum denticulate; relative widths of thorax at humeral angles, anterior spiracles, propodeal spiracles and posterior margin of dorsum of propodeum, 2·4–2·8–2·7–2·9; anterior margin of propleurae not defined by a distinct carina; all the pleural areas including the sides of propodeum, micropunctate, the latter also with obscure, close punctures posteriorly. *Abdomen* entirely black, the second tergite except the lateral fifths, and the fourth and fifth tergites with sparse, pale pubescence, elsewhere with sparse, pale pubescence, except the second tergite with a pair of small, subcircular, anterior spots separated by their own transverse diameter, and the third tergite with a broad, complete band, of dense, appressed, pale pubescence; first tergite with sparse, moderate punctures, except posteriorly the punctures close and confluent; second tergite with small, close punctures interspersed with moderate, well-separated punctures; tergites three to five punctured like the second except both series of punctures slightly smaller; pygidium irregularly rugose on the anterior two-thirds, granulate on the apical third; first sternite with a prominent, median, longitudinal carina, the profile of the carina appearing roundly emarginate; second sternite with sparse, moderate punctures, except the posterior margin with small, close punctures; sternites three to five with sparse, moderately small punctures, the latter becoming small and dense at the posterior margin of each; hypopygium with small, close punctures. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♀, CELEBES: Gorontalo, May 10–12, 1905 (*R. Shelford*), in Hope Dept. Oxford University.

This may be the female of *indagatrix menadoensis* since it was collected at the same time and place.

Timulla (*Trogaspidia*) *anthylla* (Smith).

Mutilla anthylla Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5**: 115, ♂.
Mutilla anthylla Dalle Torre, 1897, *Cat. Hymen.*, **8**: 9, ♂.
Mutilla anthylla André, 1903, *Gen. Insect.*, **11**: 38, ♂.

Holotype.—♂, BACHIAN ISLAND, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

It may be that the males of *indagatrix indagatrix*, and *i. menadoensis* are really subspecies of *anthylla*. There has been no opportunity to compare the specimens of the first two with the latter and the information necessary for a decision in the matter is not available to me.

Timulla (*Trogaspidia*) *concava* Mickel.

Mutilla analis Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3): 41, ♂ (in part) (*nec* Lepeletier).
Timulla (*Trogaspidia*) *concava* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26**: 402, ♂.

Holotype.—♂, FORMOSA: Kagi, August, 1907 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Specimens examined.—♂, Japan (*F. Muir*).

Distribution.—FORMOSA, JAPAN.

The specimen from Japan is identical in every respect, including genitalia, with those from Formosa. There is a remote possibility that the specimen is incorrectly labelled. Dr. Muir collected in both Formosa and Japan.

Timulla (*Trogaspidia*) *denotata* Mickel.

Mutilla analis Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3): 41, ♂ (in part) (*nec* Lepeletier).
Timulla (*Trogaspidia*) *denotata* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26**: 400, ♂.

Holotype.—♂, FORMOSA (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—FORMOSA.

Timulla (Trogaspidia) cydippe sp. n.

♂. Head, thorax, last two abdominal segments and legs, entirely black, the remainder of the abdomen ferruginous; clypeus with a prominent, median, dull, longitudinal carina; front, pronotum posteriorly and dorsum of propodeum with thick, appressed, pale pubescence; last abdominal tergite with a broad, median, glabrous tumescent area rounded off posteriorly; anterior third of second sternite depressed, thus the latter gibbose. Wings subfuscous, except the proximal third hyaline. Length, 13 mm. *Head* entirely black, clothed with sparse, erect, pale pubescence, except the lateral areas of clypeus, and the front, with thick, appressed, pale pubescence, and the genae also with sparse, appressed, pale pubescence; mandibles relatively slender, excised beneath near the base forming a conspicuous tooth, edentate at the apex, and with a small, distinct tooth within near the apex; median area of clypeus glabrous, impunctate, with a prominent, median, dull, longitudinal carina, terminating anteriorly at the transverse, punctate line; scape distinctly bicarinate beneath; first segment of flagellum about equal in length to the second; antennal scrobes distinctly carinate above; front, vertex, and genae with moderate, close, confluent punctures, those on the genae slightly smaller than on the front and vertex; relative widths of head and thorax at the tegulae, 4·6–5·3. *Thorax* entirely black, the posterior portion of pronotum, the dorsum of propodeum, and mesopleurae with thick, appressed, pale pubescence, the mesonotum and anterior half of scutellum with sparse, erect, black pubescence, elsewhere with sparse, erect, pale pubescence; pronotum, mesonotum and scutellum with moderately large, close, confluent punctures, those on the scutellum dense and deep; dorsum and posterior face of propodeum rounded into one another, broadly reticulate; enclosed space of dorsum of propodeum elongate, the proximal third about twice as broad as the distal two-thirds, slightly elevated at the distal end; dorsum and sides of propodeum separated by a raised line; propleurae defined anteriorly by a carina, longitudinally rugose, micropunctate and micropubescent; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with moderately large, close, confluent punctures, except anteriorly micropunctate and micropubescent; metapleurae micropunctate and micropubescent except ventrally with moderate, shallow punctures; posterior third of sides of propodeum reticulate, the remainder micropunctate and micropubescent; tegulae glabrous, impunctate except the anterior and inner margins punctate and black pubescent. *Abdomen* ferruginous, except the last two segments black, clothed with sparse, pale pubescence, except the last two segments with sparse, blackish pubescence; first tergite with moderate, sparse punctures; median, longitudinal third of second tergite with scattered, moderately small punctures, the lateral thirds with moderate, separated, distinct punctures; second tergite with an obscure, transverse, median, angulate ridge, thus obscurely gibbose; tergites three to six with scattered, small punctures; last tergite with a median, longitudinal, glabrous, tumescent area, rounded off posteriorly, the lateral areas with close, moderate punctures; first sternite with a median, longitudinal carina on the anterior two-thirds; anterior third of second sternite depressed, thus somewhat gibbose, the depressed area slightly elevated medially at the anterior margin; second sternite with moderate, separated punctures; sternites three to six with sparse, moderately small punctures; seventh sternite with a pair of small tubercles at the postero-lateral angles; hypopygium with a pair of lateral, elevated, glabrous ridges, each terminating posteriorly in an acute tubercle, the ridges dividing the distal half into equal thirds; hypopygium with small punctures posteriorly. Distal two-thirds of *wings* subfuscous, the proximal third hyaline; cell 2nd $R_1 + R_2$ truncate at the apex, very slightly longer than cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at seven-twelfths the distance from base to apex; cell R_4 almost obsolete, receiving vein M_2 slightly beyond the middle; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Pontianak (*F. Muir*), in University of Minnesota collection.

Paratypes.—♂, Borneo: Kuching, July 20, 1899 (*Dyak*); ♂, Borneo: Kuching, August 14, 1899 (*Dyak*); ♂, Borneo: Kuching, September 19, 1899 (*Dyak*).

Superficially this seems to be related to *denotata*, but the genitalia of the two are not similar. The colour of the abdomen, form of the clypeus, and form of the second abdominal segment distinguish it from other species.

Timulla (Trogaspidia) erato sp. n. Fig. 2.

Mutilla ira Cameron, 1902, *J. Straits Br. R. Asiat. Soc.*, **37** : 74, ♂ (in part).

♂. Head, thorax, last four abdominal segments and legs, black, the first three abdominal segments ferruginous; median area of clypeus deeply concave, the lateral and anterior margins elevated, and the anterior margin medially very deeply, roundly notched; scape flattened distally with a single distinct carina beneath; hypopygium without lateral ridges but with a pair of proximal, distinct, median tubercles; calcaria of anterior tibiae much broadened and flattened, conspicuously spatulate distally, the inner margin of the spatula with a small denticle near the distal end. Wings moderately fuscous. Length, 16 mm. *Head* entirely black, clothed with sparse, erect, pale pubescence, except the front with sparse, appressed, pale pubescence, and the lateral areas of clypeus as well as the posterior half of the median area with thick, appressed, pale pubescence; mandibles moderately robust, deeply excised beneath near the base forming a prominent tooth, edentate at the apex and with a distinct tooth within near the apex; clypeus as above, the antero-lateral margins glabrous, impunctate; scape flattened and broadened distally, with a single well-developed carina beneath; first segment of flagellum slightly shorter than the second when viewed from beneath; antennal scrobes carinate above; front and vertex with moderately large, dense, confluent punctures, the genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 5·4–6·2. *Thorax* entirely black, the posterior margin of pronotum, dorsum of propodeum and mesopleurae clothed with thick, appressed, pale pubescence, the mesonotum and anterior half of scutellum with sparse, fuscous pubescence, elsewhere with sparse, pale pubescence; pronotum, mesonotum and scutellum with large, dense, somewhat confluent punctures; lateral margins of pronotum with a low, blunt, distinct tubercle slightly behind the middle; dorsum, posterior face and sides of propodeum broadly rounded into one another, the first two broadly reticulate; enclosed space of dorsum of propodeum broad anteriorly, the anterior third two and one-half times the diameter of the posterior two-thirds, the distal end not elevated into a tubercle; anterior margin of propleurae defined by a carina; propleurae very faintly rugose, micropunctate and micropubescent; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with large, dense, confluent punctures, except anteriorly micropunctate and micropubescent; metapleurae micropunctate and micropubescent except ventrally with scattered, moderate punctures; posterior two-thirds of sides of propodeum distinctly reticulate, the anterior third micropunctate and micropubescent; tegulae large, glabrous, impunctate, except the anterior and inner margins punctate and pale pubescent. Last four *abdominal segments* black, the first three ferruginous, the abdomen clothed with sparse, pale pubescence, except the last two tergites clothed mostly with sparse, black pubescence; first tergite with sparse, moderately large punctures, except posteriorly with small, scattered punctures; second tergite with a transverse, angulate, low ridge, the area anterior to the ridge with moderate punctures, sparse medially, closer laterally, the posterior area with scattered, small punctures; tergites three to six with sparse moderately small to small punctures; last tergite very broadly, squarely truncate at the posterior margin, with a subtriangular, elongate, glabrous, median, tumescent area rounded off posteriorly, the lateral areas with small close punctures; first sternite with a prominent median carina on the anterior two-thirds; second sternite with moderately large, separated punctures, sparser medially than laterally; sternites three to six with moderately small, sparse punctures; sternite seven with a distinct, acute tubercle at each postero-lateral angle; hypopygium without lateral ridges, with a pair of median, large, acute tubercles at the anterior margin. *Wings* moderately fuscous, slightly paler on the proximal third; cell 2nd $R_1 + R_2$ squarely truncate at the apex, distinctly longer than cell $R +$ 1st R_1; cell R_5 receiving vein M_{3+4} at three-fifths the distance from base to apex; cell R_4 almost obsolete, receiving vein M_2 at two-thirds the distance from base to apex; vein *m-cu* terminating very distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria of anterior tibiae spatulate, much flattened, broadened and rounded distally, the inner margin near the distal end with a small denticle; intermediate and posterior calcaria pale.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50038 United States National Museum.

Paratypes.—2 ♂♂, Borneo: Sandakan (*Baker*); 7 ♂♂, Borneo: Bettotan, near Sandakan, 7.viii.1927–21.viii.1927 (all *C. B. K.* and *H. M. P.*); ♂, Borneo: Long Mujan, Baram River, Sarawak; November 10, 1920 (*J. C. Moulton*); ♂, Sarawak (labelled as cotype of *Mutilla ira* Cameron).

A very distinct species and easily recognisable by the anterior calcaria, the form of the clypeus, the flattened scape, and the tuberculate hypopygium. The specimens described by Cameron as *ira* represented two species, one specimen labelled " cotype " belonging here. The remaining specimens before Cameron were the same as his type of *ira*.

Timulla (*Trogaspidia*) *novobrittanica* (Cameron).

Mutilla novobrittanica Cameron, 1901, *Proc. zool. Soc. Lond.*, **1901** (1): 235, ♂.

Holotype.—♂, New Britain, in British Museum (Natural History).

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *agapeta* (Cameron).

Mutilla agapeta, Cameron, 1902, *J. Straits Br. R. Asiat. Soc.*, **37**: 77, ♂.

Holotype.—♂, Borneo, in British Museum (Natural History).

Distribution.—Known only from the type locality.

The hypopygium of the type specimen has the lateral ridges closer to the midline than in most species, and the ridges strongly elevated, almost appearing bifurcate.

Timulla (Trogaspidia) boniensis sp. n.

♂. Head, thorax, last four abdominal segments and legs, black, the first three abdominal segments ferruginous; median area of clypeus glabrous, impunctate, with a prominent, median, longitudinal ridge; pronotum and propodeum without appressed, pale pubescence. Wings fuscous. Length, 15 mm. *Head* black, clothed with sparse, erect, pale pubescence, except the lateral areas of clypeus with dense, appressed, pale pubescence, and the median, anterior area of front with somewhat thick, appressed, pale pubescence; mandibles moderately robust, excised beneath near the base forming a prominent tooth beneath, edentate at the apex and with a distinct tooth within near the apex; median area of clypeus glabrous, impunctate, with a prominent, median, longitudinal ridge, terminating bluntly at the anterior, submarginal punctate line; clypeus bicarinate beneath; first segment of flagellum slightly longer than the second; antennal scrobes carinate above; front with moderately large, close, confluent punctures; vertex with moderate, close punctures; genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 5·4–6·0. *Thorax* entirely black, sparsely clothed with erect, pale pubescence, except the mesonotum and anterior half of scutellum with sparse, black pubescence, and the mesopleurae with sparse, appressed, pale pubescence in addition to the erect pubescence; pronotum with moderately large, dense, confluent punctures; mesonotum with moderately large, close, distinct punctures; scutellum with moderately large, dense, confluent punctures; dorsum and posterior face of propodeum rounded into one another, broadly reticulate; enclosed space of dorsum of propodeum elongate, gradually and only slightly narrowed posteriorly, with a median, longitudinal carina within; anterior margin of propleurae defined by an obscure carina; propleura longitudinally rugose; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with moderately large, dense, confluent punctures, except anteriorly and at the posterior margin micropunctate and micropubescent; metapleurae micropunctate and micropubescent, except ventrally with sparse, moderate, shallow punctures; posterior two-thirds of sides of propodeum reticulate, the anterior third micropunctate and micropubescent; tegulae large, glabrous, impunctate, except the anterior and inner margins punctate and fuscous pubescent. First three *abdominal segments* ferruginous, the remainder of the abdomen black, clothed with sparse, pale pubescence, except the last two tergites with sparse, black pubescence; first tergite with moderate, sparse punctures except at the posterior margin the punctures small and closer; disk of second tergite glabrous, almost impunctate, the anterior margin and large lateral areas with moderate, separated, distinct punctures, the posterior third with moderately small, sparse punctures; tergites three to six with sparse, small punctures, the latter closer laterally than medially; last tergite with an elongate, subtriangular, median, glabrous, tumescent area rounded off posteriorly; lateral areas of last tergite with moderately small, dense punctures; first sternite with a median, longitudinal carina, the latter elevated posteriorly into a small, distinct tooth; second sternite with moderately large, close, distinct punctures; sternites three to six with small, separated punctures, the latter closer on each sternite posteriorly; seventh sternite with a small tubercle at each postero-lateral angle; hypopygium with a pair of lateral, glabrous ridges terminating posteriorly in an acute tubercle, the latter directed posteriorly. *Wings* fuscous throughout; cell 2nd $R_1 + R_2$ rounded at the apex, distinctly longer than cell $R +$ 1st R_1; cell R_5 receiving vein M_{3+4} at two-thirds the distance from base to apex; cell R_4 almost obsolete, receiving vein M_2 distinctly beyond the middle; vein *m-cu* terminating anterior to vein $M_4 + Cu_1$ a distance equal to half the length of the latter. *Legs* black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, CELEBES: Makassar, December, 1908 (*F. Muir*), in University of Minnesota collection.

Paratype.—♂, CELEBES: Makassar, December, 1908 (*F. Muir*); ♂, CELEBES: Makassar, May 27, 1933 (*H. T. Pagden*).

The first paratype is much smaller (length, 8 mm.) than the holotype, and the head and thorax are sparsely punctured; the genitalia of the two, however, are identical. The second paratype is like the type in size and sculpture. Superficially this species has somewhat the appearance of *suspiciosa suspiciosa*, but the hypopygial ridges are more closely placed, the first abdominal segment is entirely ferruginous, and the genitalia of the two are unlike.

Timulla (*Trogaspidia*) *rhea* Mickel.

Mutilla gribodoi Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 42, ♂ (*nec* Magretti).
Timulla (*Trogaspidia*) *rhea* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 406, ♂.

Holotype.—♂, FORMOSA: Hoozan, October, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

Timulla (*Trogaspidia*) *suspiciosa suspiciosa* (Smith).

Mutilla suspiciosa Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 84, ♂.
Mutilla suspiciosa Dalle Torre, 1897, *Cat. Hymen.*, **8** : 90, ♂.
Mutilla casiphia Cameron, 1902, *Entomologist*, **35** : 207, ♂.
Mutilla suspiciosa André, 1903, *Gen. Insect.*, **11** : 41, ♂.

Holotype.—♂, BORNEO: Sarawak, in Saunders' coll., Hope Dept. Oxford University. The type of Cameron's *casiphia* is in the British Museum Natural History).

Specimens examined.—9 ♂♂, BORNEO: Sandakan (*Baker*); 3 ♂♂, BORNEO: Bettotan, near Sandakan, 13.viii.1927–24.viii.1927 (all *C. B. K.* and *H. M. P.*); BORNEO: Kuching, 1899 (*Dyak*); ♂, BORNEO: Pontianak (*F. Muir*).

Distribution.—BORNEO.

I have compared the type specimens of *suspiciosa* and *casiphia* and find them to be identical. The records of this subspecies from India, Java, Philippine Islands and other islands in the South Seas by Smith, Bingham, André and Zavattari are all based on misidentifications. A subspecies of *suspiciosa* is known from China, and a second subspecies is known from Formosa. Curiously enough, no subspecies is known from the Philippine Islands.

Timulla (*Trogaspidia*) *sibylla* (Smith).

Mutilla sibylla Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2**: 86, ♀.
Mutilla gispa Cameron, 1902, *J. Straits Br. R. Asiat. Soc.*, **37**: 139, ♀.

Holotype.—♀, BORNEO: Sarawak, in Saunders' coll., Hope Dept. Oxford University. The type of Cameron's *gispa* is in the British Museum (Natural History).

Specimens examined.—6 ♀♀, BORNEO: Sandakan (*Baker*); ♀, BORNEO: Pontianak (*F. Muir*); BRITISH N. BORNEO: Mt. Kinabalu, Kiau, May 16, 1929 (*H. M. Pendlebury*).

Distribution.—BORNEO.

Smith (1861) states that this female has been taken *in coitu* with subsp. *suspiciosa* Smith. It has not been possible to examine the specimens Smith referred to, and since *suspiciosa* has been misidentified so many times it seems best to regard *sibylla* as distinct until further evidence is available. Superficially this female is much like *minor* Ashmead, but differs in the second tergite, being distinctly gibbose at the middle anteriorly. I have compared the types of *sibylla* and *gispa* and find them to be identical.

Timulla (*Trogaspidia*) *suspiciosa discolor* Mickel.

Mutilla analis Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3): 41, ♂ (in part) (*nec* Lepeletier).
Timulla (*Trogaspidia*) *suspiciosa discolor* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26**: 404, ♂.

Holotype.—♂, FORMOSA: Taihorinsho, September, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *pendleburyi* Pagden.

Timulla (*Trogaspidia*) *pendleburyi* Pagden, 1934, *J. F.M.S. Mus.*, **17**: 421–426, figs. 1 and 2, ♂ and ♀.

Holotype and Allotype.—♂ and ♀, FEDERATED MALAY STATES: Ampang, Kuala Lumpur, January 10, 1932, in British Museum (Natural History).

Distribution.—FEDERATED MALAY STATES.

Timulla (Trogaspidia) shelfordi sp. n.

♂. Head, thorax, anterior third of first abdominal tergite, first sternite, last four abdominal segments and legs, black, the posterior two-thirds of first abdominal tergite and second and third abdominal segments ferruginous; median area of clypeus glabrous, impunctate, the anterior half with a conspicuous, median, glabrous, subconical tubercle, without a median, longitudinal ridge posterior to the tubercle; lateral ridges of hypopygium not widely separated, the distance between the lateral margin of the hypopygium and a lateral ridge slightly greater than half the distance between the lateral ridges. Length, 16 mm. *Head* entirely black, clothed with sparse, erect, pale pubescence, except the vicinity of the ocellar area with sparse, erect, fuscous pubescence, the lateral areas of the clypeus with thick, appressed, pale pubescence, and the front and genae with sparse, appressed pale pubescence in addition to the above; mandibles moderately robust, deeply excised beneath near the base forming a prominent tooth beneath, edentate at the apex and with a distinct tooth within near the apex; clypeus as described above, the tubercle just posterior to the anterior, transverse, punctate line; scape strongly bicarinate beneath; first segment of flagellum slightly longer than the second when viewed from beneath; antennal scrobes carinate above; front with moderately large, dense, confluent punctures; vertex with moderate, close punctures; genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 5·8–6·3. *Thorax* entirely black, sparsely clothed with erect, pale pubescence, except the mesonotum and anterior half of scutellum with sparse, erect, black pubescence, and the dorsum of propodeum and mesopleurae with somewhat thick, appressed pubescence; pronotum and scutellum with moderately large, dense, deep, confluent punctures, the mesonotum with moderate, dense, almost entirely distinct punctures; dorsum and posterior face of propodeum separated medially by an obscure, transverse, crenulate ridge, both broadly reticulate; enclosed space of dorsum of propodeum elongate, narrowed posteriorly, about twice as wide anteriorly as posteriorly, without a median carina within; anterior margin of propleurae defined by an obscure carina; propleurae longitudinally rugose; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with moderate, dense, confluent punctures, except anteriorly and posteriorly micropunctate and micropubescent; metapleurae micropunctate and micropubescent, except moderate, sparse, shallow punctures ventrally; posterior two-thirds of sides of propodeum reticulate, the anterior third micropunctate and micropubescent; tegulae large, glabrous, impunctate, except the anterior and inner margins punctate and blackish pubescent. *Abdomen* black, except the posterior two-thirds of the first tergite, and segments two and three entirely, ferruginous, clothed with sparse, pale pubescence, except the last two segments with sparse, fuscous to black pubescence; first tergite with moderately large, sparse punctures except the posterior margin with small, sparse punctures; disk of second tergite glabrous, practically impunctate, the lateral thirds with moderate, sparse punctures, the latter at the anterior, median margin sparse, moderate, on the posterior third small and scattered; tergites three to six with sparse small punctures, the latter closer laterally on each tergite; last tergite with a broad, median, elongate, tumescent, glabrous area, rounded off posteriorly; lateral areas of last tergite with small, close punctures; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina in profile broadly, shallowly emarginate; second sternite with moderate, sparse punctures; sternites three to six with small, sparse punctures; sternite seven with a small tubercle at each postero-lateral angle; hypopygial ridges as above. *Wings* fuscous, somewhat paler on the proximal third; cell 2nd $R_1 + R_2$ squarely truncate at the apex, slightly but distinctly longer than cell R + 1st R_1; cell R_5 receiving vein M_{3+4} almost two-thirds the distance from base to apex; cell R_4 almost obsolete, receiving vein M_2 at three-fifths the distance from base to apex; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Kuching, September 28, 1899 (*Dyak*), in Hope Dept. Oxford University.

Distinct from similar appearing species by the subconical, anterior, median tubercle on the glabrous, median area of clypeus. An examination of the genitalia showed this species to be distinct from other Borneo forms.

Timulla (*Trogaspidia*) *pagdeni pagdeni* Mickel.

Timulla (*Trogaspidia*) *pagdeni* Mickel, 1933, *Lingnan Sci. J.*, **12** : 284, ♂ and ♀.

Holotype.—♂, Federated Malay States : Serdang, April 25, 1928 (*H. T. Pagden*), *in coitu* with female (latter = allotype). Both holotype and allotype in British Museum (Natural History).

Distribution.—Federated Malay States : Selangor and Pahang, and Siam.

Timulla (*Trogaspidia*) *fervida* (Smith).

Mutilla fervida Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 76, ♂ and ♀.
Mutilla fervida Dalle Torre, 1897, *Cat. Hymen.*, **8** : 40, ♂ and ♀.
Mutilla fervida André, 1903, *Gen. Insect.*, **11** : 39, ♂ and ♀.
Mutilla fervida Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 76, ♂ and ♀.

Holotype.—♀, Celebes, in Saunders' coll., Hope Dept. Oxford University.

Allotype.—♂, Celebes, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—♂ and ♀, Celebes : Makassar.

Distribution.—Known only from Celebes.

Both specimens have been compared with the type material. The ♀ (length, 7 mm.) is much smaller than the ♂ (length, 22 mm.).

Timulla (*Trogaspidia*) *eremita eremita* Mickel.

Timulla (*Trogaspidia*) *eremita eremita* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 156, ♂ and ♀.

Holotype.—♂, Philippine Islands : Tangcolan, Bukidnon Province, Mindanao (*Baker*), in United States National Museum.

Allotype.—♀, Philippine Islands : Tangcolan, Bukidnon Province, Mindanao (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : islands of Luzon, Samar, Biliran, Negros, Panay, Mindanao and Basilan.

Timulla (*Trogaspidia*) *eremita umbra* Mickel.

Mutilla suspiciosa Bingham, 1895, *Ann. Mag. nat. Hist.*, (6) **16** : 440, ♂ and ♀ (in part) (*nec* Smith).
Timulla (*Trogaspidia*) *eremita umbra* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 161, ♂ and ♀.

Holotype.—♂, Philippine Islands : Mt. Banahao, Luzon (*Baker*), in United States National Museum.

Allotype.—♀, Philippine Islands : Mt. Banahao, Luzon (*Baker*).

Distribution.—Philippine Islands : islands of Luzon and Polillo.

Timulla (*Trogaspidia*) *luzonica luzonica* (Radoskowski).

Mutilla luzonica Radoskowski, 1885, *Horae Soc. ent. ross.*, **19** : 27, pl. 4, fig. 28, ♂.
Mutilla luzonica Dalle Torre, 1897, *Cat. Hymen.*, **8** : 55, ♂.
Mutilla luzonica André, 1899, *Ann. Soc. ent. Fr.*, **68** : 31, ♂. (Redescription of type.)
Mutilla luzonica André, 1903, *Gen. Insect.*, **11** : 40, ♂.
Mutilla luzonica Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
Timulla (*Trogaspidia*) *luzonica luzonica* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 162, pl. 1, fig. 9, ♂.

Holotype.—♂, Philippine Islands : Luzon, in Musée Physiographique de l'Académie Polonaise des Sciences, Cracovie.

Distribution.—Philippine Islands : Luzon.

Timulla (*Trogaspidia*) *luzonica panayensis* Mickel.

Timulla (*Trogaspidia*) *luzonica panayensis* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 162, pl. 1, fig. 10, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Culasi, Panay (*McGregor*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Panay, Negros and Sibuyan.

Timulla (*Trogaspidia*) *ovatula ovatula* Mickel.

Timulla (*Trogaspidia*) *ovatula ovatula* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 163, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Sibuyan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *ovatula aurifera* Mickel.

Mutilla philippinensis Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 226–227, ♀.
Timulla (*Trogaspidia*) *ovatula aurifera* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 165, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Bulbalan, Luzon, in University of Minnesota collection.

Distribution.—PHILIPPINE ISLANDS : Luzon.

Timulla (*Trogaspidia*) *minae* (Zavattari).

Mutilla minae Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 29, ♀.
Timulla (*Trogaspidia*) *minae* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 413. ♀.

Lectotype.—♀, FORMOSA : Taihorinsho, October, 1909 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from Formosa.

Timulla (*Trogaspidia*) *depressula* Mickel.

Mutilla suspiciosa Bingham, 1895, *Ann. Mag. nat. Hist.*, (6) **16** : 440–441, ♂ (in part) (*nec* Smith).
Timulla (*Trogaspidia*) *depressula* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 166, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : Luzon.

Timulla (*Trogaspidia*) *bakeri* Mickel.

Timulla (*Trogaspidia*) *bakeri* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 168, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Kolambugan, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Samar, Mindanao and Basilan.

Timulla (*Trogaspidia*) *ianthea ianthea* (Smith).

Mutilla ianthea Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 115, ♂ and ♀.
?*Mutilla janthea* André, 1896, *Termes. Fuzetek*, **19** : 9, ♀.
Mutilla janthea Dalle Torre, 1897, *Cat. Hymen.*, **8** : 48, ♂ and ♀.
Mutilla janthea André, 1903, *Gen. Insect.*, **11** : 39, ♂ and ♀.

Holotype.—♀, Bachian, in Saunders' coll., Hope Dept. Oxford University.

Allotype.—♂, Bachian, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *ianthea rubiginosa* (André).

Mutilla rubiginosa André, 1896, *Termes. Fuzetek*, **19** : 16, ♂.
Mutilla rubiginosa André, 1903, *Gen. Insect.*, **11** : 40, ♂.

Holotype.—♂, CERAM, in Hungarian National Museum, Budapest.

Allotype.—♀, CERAM : Piroe, January, 1909 (*F. Muir*), in University of Minnesota collection.

Specimens examined.—6 ♂♂, ♀, CERAM : Piroe, January, 1909 (*F. Muir*); ♀, AMBOINA, 1869 (*Doleschal*).

The females are almost identical with those of the subspecies *ianthea*, the only difference being in the deeply emarginate median carina of the first abdominal sternite.

T. i. rubiginosa is unquestionably no more than a subspecies of *ianthea*. The genitalia of the two males are practically the same, and the only external difference is in the colour of the propodeum, which is constant in the six males from Ceram. I have not examined the males recorded from Amboina by Zavattari (1913). The female recorded from Amboina here is identical with the two females from CERAM : Piroe.

Timulla (*Trogaspidia*) *haemarrhoa* (Zavattari).

Mutilla haemarrhoa Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 101, ♂.

Holotype.—♂, Sumbawa, in Museo Cicivo di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

This species is related to the seven following species and subspecies; all have the same general form of clypeus.

Timulla (*Trogaspidia*) *tegularia* Mickel.

Timulla (*Trogaspidia*) *tegularia* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 169, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Los Banos, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Luzon, Sibuyan, Samar, Negros, Panay and Mindanao.

Timulla (*Trogaspidia*) *pustulata* (Smith).

Mutilla pustulata Smith, 1873, *Trans. ent. Soc. Lond.*, **1873** : 182, ♂.
Mutilla petulans Smith, 1874, *Trans. ent. Soc. Lond.*, **1873** : 408, ♂.
Mutilla petulans Dalle Torre, 1897, *Cat. Hymen.*, **8** : 72, ♂.
Mutilla pustulata Dalle Torre, 1897, *Cat. Hymen.*, **8** : 75, ♂.
——— *petulans* André, 1903, *Gen. Insect.*, **11** : 71, ♂.
——— *pustulata* André, 1903, *Gen. Insect.*, **11** : 71, ♂.
Mutilla petulans, Matsumura, 1931, *6000 Illust. Ins. Japan Empire* : 29, ♂.
Mutilla petulans Matsumura, 1932, *Illust. Common Ins. Japan*, **4** : 8 (Japanese text) : 11 (English text), pl. 2, fig. 20, ♂.

Holotype of *pustulata*.—Lost.

Holotype of *petulans*.—♂, JAPAN : Hiogo, in British Museum (Natural History).

Specimens examined.—♂, JAPAN : Keiwaifu, August 20, 1922 (*C. Teranishi*); ♂, JAPAN : Mino, September 6, 1914.

If the descriptions of *pustulata* and *petulans* be compared there can be no doubt that both descriptions are of the same species. See discussion of Smith's papers (1873, 1874) under *Squamulotilla ardescens* (Smith).

Timulla (*Trogaspidia*) *tethys tethys* Mickel. Fig. 3.

Timulla (*Trogaspidia*) *tethys* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 172, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Port Princesa, Palawan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *tethys krianae* Pagden.

Timulla (*Trogaspidia*) *krianae* Pagden, 1934, *J. F.M.S. Mus.*, **17** : 433–439, figs. 7–11, ♂.

Holotype.—♂, FEDERATED MALAY STATES : Selinsing, Perak, June 24, 1930, in British Museum (Natural History).

Distribution.—FEDERATED MALAY STATES.

I have examined a paratype of this species and find it to be a subsp. of *tethys* Mickel. The differences between the various subspecies are indicated in the key.

Timulla (Trogaspidia) tethys prodiga subsp. n. Fig. 4.

♂. Externally identical with subsp. *tethys*; genitalia differs in having the prominent hook at the distal end of the right uncus lying between two teeth, one of the latter on the inner surface and one on the outer surface; outer tooth narrow at the base, spiniform. Length, 9 mm.

Holotype.—♂, BORNEO : Sandakan (*Baker*), Cat. no. 50039, United States National Museum.

Paratypes.—5 ♂♂, BORNEO : Sandakan (*Baker*); ♂, BORNEO : Kuching, Sarawak.

Timulla (Trogaspidia) tethys melanesia subsp. n. Fig. 5.

♂. Externally identical with subsp. *tethys*; genitalia similar to subsp. *prodiga*, but tooth on outer, distal face of uncus broad at the base, dentiform. Length, 8 mm.

Holotype.—♂, AMBOINA (*F. Muir*), in University of Minnesota collection.

Timulla (Trogaspidia) sarawaka sp. n. Fig. 6.

♂. Head, thorax, last three abdominal segments, and legs, black, the first four abdominal segments, ferruginous; median area of clypeus glabrous, impunctate, with an anterior, distinct, transverse, submarginal carina, the area posterior to the carina, only very slightly concave, and with an obscure, median, longitudinal ridge; median, glabrous area of last tergite terminating in a prominent tubercle; hypopygium with distinct lateral, glabrous ridges. Length, 9 mm. *Head* entirely black, clothed with sparse, erect, pale pubescence, except the lateral areas of clypeus with dense, appressed, pale pubescence; mandibles excised beneath forming a prominent tooth beneath near the base, moderately robust, edentate at the apex and with a distinct tooth within near the apex; clypeus as described above; antennae lacking in the type; front, vertex and genae with moderate, shallow, close punctures; relative widths of head and thorax at the tegulae, 3·7–3·9. *Thorax* entirely black, clothed with sparse, erect, pale pubescence, except the mesonotum and anterior half of scutellum with sparse, erect, black pubescence, the dorsum of propodeum and mesopleurae with thick, appressed, pale pubescence, and the pronotum with sparse, appressed, pale pubescence; pronotum, mesonotum and scutellum with moderate, dense, shallow, slightly confluent punctures; dorsum and posterior face of propodeum rounded into one another, distinctly reticulate; enclosed space of dorsum of propodeum subtriangular, the apex at the posterior margin elevated into a small tubercle; anterior margin of propleurae defined by an obscure carina; propleurae longitudinally rugose; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow; metapleurae micropunctate and micropubescent except for sparse, moderate shallow punctures ventrally; posterior half of sides of propodeum reticulate, the anterior half micropunctate and micropubescent; tegulae glabrous, impunctate, except the anterior and inner margins punctate and black pubescent. First four *abdominal segments* ferruginous, the fourth tinged with black posteriorly, the last three abdominal segments entirely black; abdomen clothed with sparse, pale pubescence, except the last two segments with blackish pubescence, the fifth segment apparently without a band of pale pubescence; first tergite with moderate, sparse punctures; second tergite with an obscure, transverse, angulate ridge, thus slightly gibbose; disk of second tergite glabrous, practically impunctate, the lateral areas anterior to the ridge with moderate, distinct punctures, the area posterior to the ridge with sparse, small punctures; tergites three to six with small punctures, sparse medially, close laterally; last tergite with a median, longitudinal glabrous ridge terminating near the posterior margin in a prominent acute tubercle; lateral areas of last tergite with moderately small, dense punctures; first sternite with a prominent, median, longitudinal carina; second sternite with moderately large, distinct punctures; sternites three to six with small, close punctures at the posterior margin; hypopygium with a pair of lateral, glabrous ridges, each terminating in a posteriorly directed, acute tubercle. *Wings* subfuscous, except the proximal third hyaline; cell 2nd $R_1 + R_2$ obscurely truncate at the apex, about equal in length to cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at five-eighths the distance from base to apex; cell R_4 almost obsolete, receiving the almost obsolete vein M_2 at the postero-apical angle; vein *m-cu* terminating slightly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, BORNEO: Kuching, Sarawak, in Cornell University collection, Ithaca, New York.

Very similar in appearance to *tethys* subsp. *prodiga*, but differs in the form of the clypeus, in having the fourth segment tinged with black posteriorly and the last three segments entirely black, and the absence of a band of pale pubescence on the fifth tergite.

Timulla (*Trogaspidia*) *elpinice* Mickel.

Mutilla analis Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 41, ♂ (in part) (*nec* Lepeletier).
Timulla (*Trogaspidia*) *elpinice* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 395, ♂.

Holotype.—♂, FORMOSA: Takao, June 23, 1907 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

Timulla (*Trogaspidia*) *bataviana* (André).

Mutilla bataviana André, 1909, *Notes Leyden Mus.*, **31** : 177, ♂.

Type.—♂, JAVA, in Leyden Museum.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *merops* (Smith).

Mutilla merops Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 115, female (*nec* male).
Mutilla merops Dalle Torre, 1897, *Cat. Hymen.*, **8** : 62, ♀.
Mutilla merops André, 1903, *Gen. Insect.*, **11** : 40, ♀.

Lectotype.—♀, BACHIAN, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—♀, BACHIAN.

Distribution.—Known only from the type locality.

The male specimen incorrectly associated with the female lectotype by Smith is a representative of the genus *Odontomutilla* and is described herein as *O. apiastra* nom. n.

The specimens recorded by André (1896) as this species were evidently misidentified as André, describing the pygidial region, states that his specimens are without a well-defined pygidial area. I have not seen André's specimens, but they are probably examples of the genus *Odontomutilla.* The lectotype has a well-defined pygidial area strongly rugose, more or less longitudinally so on the anterior third, transversely so on the posterior two-thirds.

Zavattari's record (1913) is a repetition of the Halmahera specimen recorded by André (1896) and is therefore a misidentification.

Timulla (*Trogaspidia*) *serafica* (Zavattari).

Mutilla serafica Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 77, ♀.

Lectotype.—♀, SUMBAWA : Tambora, in Museo Civico di Storia naturale, Genoa.

I have examined the Sumbawa specimen here designated as lectotype, but have not seen the two other specimens recorded by Zavattari from the islands of Solor and Amboina.

Timulla (*Trogaspidia*) *vicina vicina* (Sichel & Radoskowski).

Mutilla vicina Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 228, ♀.
Mutilla vicina Dalle Torre, 1897, *Cat. Hymen.*, **8** : 96, ♀.
Mutilla vicina André, 1899, *Ann. Soc. ent. Fr.*, **68** : 32, ♀.
Mutilla vicina André, 1903, *Gen. Insect.*, **11** : 41, ♀.

Lectotype.—♀, AMBOINA, in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from the type locality.

I have not been able to examine Mantero's (1900) material, but believe that the specimens recorded by him are not conspecific with this species.

The following supplementary description was made from the lectotype specimen :

Head entirely black, including the mandibles and antennal tubercles; front and vertex black pubescent, the genae with pale pubescence. *Thorax* entirely ferruginous, not broader posteriorly than anteriorly; mesonotal-scutellar suture very well developed; scutellar scale broad; lateral margins of posterior face of propodeum denticulate; sides of propodeum almost impunctate, with large, indistinct, shallow punctures posteriorly. *Abdomen* black; apical margins of first and second tergites entirely black; second tergite with a pair of small, anterior, pale pubescent spots, the distance between them slightly less than twice their transverse diameter; posterior half of lateral margins of second tergite with dense, pale pubescence; third tergite with a broad band of dense, pale pubescence, interrupted medially with black; tergites four and five black pubescent; pygidial area irregularly rugose throughout; second sternite with scattered, moderate punctures, and scattered, erect, pale hairs throughout, except the apical margin with fine close punctures, and dense, pale pubescence; third sternite with a similar apical fringe of pale pubescence; fourth sternite with the median third of the apical margin pale pubescent, the lateral thirds black, except for scattered erect, pale hairs; apical fringe of fifth sternite black, except for scattered, erect, pale hairs. *Legs* including coxae entirely black.

Timulla (Trogaspidia) vicina laratensis subsp. n.

♀. Like the subsp. *vicina* Sichel & Radoskowski, but smaller and with the pale pubescent spots of the second tergite more closely spaced, the distance between them equal to only one and one-fourth times the transverse diameter of one; pale pubescent band of third tergite distinctly interrupted medially; pygidium irregularly rugose throughout. Length, 9 mm.

Holotype.—♀, Larat Island, December, 1908 (*F. Muir*), in University of Minnesota collection.

Timulla (*Trogaspidia*) *lodina* (Cameron).

Mutilla lodina Cameron, 1905, *Tijdschr. Ent.*, **48** : 50, ♀.

Holotype.—♀, Borneo : Barabei, Z. O. Afd. (*A. Pool*), 1883, in Zoologisch Museum, Amsterdam.

Distribution.—Known only from the type locality.

The following supplementary description was made from the holotype specimen :

Head, abdomen and legs black; thorax entirely ferruginous. *Antennal tubercles* ferruginous; front and anterior portion of vertex, black pubescent; posterior portion of vertex and genae with sparse, pale pubescence. Dorsum of *thorax* densely, confluently punctate, the dorsum and posterior face of propodeum distinctly reticulate; thorax not broader posteriorly than anteriorly, slightly constricted at the mesonotal area; scutellar scale present; lateral margins of dorsum and posterior face of propodeum denticulate. Apical fringe of first and second *abdominal tergites* entirely black; second tergite with a pair of anterior, circular spots of dense, pale pubescence and the lateral margins with sparse, pale pubescence; third tergite clothed with dense, appressed, pale pubescence interrupted medially with black, the black spot rectangular and slightly longer than broad; tergites four and five entirely black pubescent; basal margin of pygidial tergite with pale pubescence; pygidial area finely, longitudinally rugose on the anterior half, granulate on the posterior half; first sternite ferruginous; apical fringes of all the sternites, pale. *Anterior coxae* black, the intermediate and posterior coxae, ferruginous, except the apical margins black.

Timulla (*Trogaspidia*) *manilensis* (Brown).

Mutilla manilensis Brown, 1906, *Philipp. J. Sci.*, **1** : 685, ♀.
Timulla (*Trogaspidia*) *manilensis* Mickel, 1934; *Philipp. J. Sci.*, **54** (1) : 174, ♀.

Type.—♀, Philippine Islands : Manila, Luzon (location unknown).

Distribution.—Philippine Islands : islands of Luzon, Panay, Negros, Mindanao, Basilan and Palawan.

Timulla (*Trogaspidia*) *nereis* (Kohl).

Mutilla nereis Kohl, 1882, *Verh. zool.-bot. Ges. Wien*, **32** : 476, pl. 23, fig. 2, ♀.
Mutilla nereis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 65, ♀.
Mutilla nereis André, 1903, *Gen. Insect.*, **11** : 40, ♀.

Holotype.—♀, Java, in Naturhistorisches Staatsmuseum, Vienna.

Distribution.—Known only from the unique type.

It is very improbable that the specimen recorded by André (1904) from Indo-China is the same as this species.

Timulla (**Trogaspidia**) **oceanitis** sp. n.

♀. Head, thorax and legs, black, the thorax and antennal tubercles, ferruginous; vertex posterior to the eye-margins, a pair of subcircular, anterior spots on tergite two, a complete, broad band on tergite three, and a narrowly interrupted, broad band on tergite four, all of dense, appressed, pale pubescence; pygidium irregularly rugose on the anterior half, granulated on the posterior half. Length, 7·5 mm. *Head* entirely black, except the mandibles medially, and the antennal tubercles, ferruginous; mandibles slender, edentate at the apex and with a small tooth within near the apex; clypeus elevated posteriorly, the elevated margin arcuate, and with a small, median tubercle immediately behind the elevated margin; scape with sparse, small punctures and sparse, pale pubescence; first segment of flagellum about one and one-half times longer than the second; antennal scrobes distinctly carinate above; front, vertex and genae with moderate, dense, confluent punctures; front clothed with sparse, suberect, dark fuscous pubescence; vertex with dense, appressed, pale pubescence, and genae with sparse, pale pubescence; posterior margin of genae rounded, not carinate; relative widths of head and thorax, 3·25–2·7. *Thorax* entirely ferruginous, the dorsum clothed with erect and recumbent, sparse, dark ferruginous pubescence, the posterior face of propodeum with sparse, erect, pale pubescence, and all the pleural areas pale micropubescent; dorsum with large, dense, deep, confluent punctures, becoming longitudinally rugoso-punctate on the dorsum of propodeum; humeral angles angulate but not prominent; pronotum narrower anteriorly than posteriorly; lateral margins of mesonotum crenulate; dorsum of thorax slightly broader behind than in front, relative widths at humeral angles, anterior spiracles and dorsum of propodeum, 2·5–2·7–2·9; scutellar scale present but small; lateral margins of posterior face of propodeum denticulate; pleural areas including sides of propodeum, entirely micropunctate, the latter with a few, small, obscure punctures posteriorly. *Abdomen* entirely black, clothed with sparse, pale pubescence, except the median three-fifths of tergite two and all of tergite five with black pubescence, and a pair of subcircular, anterior spots on second tergite, a broad band covering all of tergite three, and a broad band narrowly interrupted medially with black on tergite four, all of dense, appressed, pale pubescence; pale pubescent spots on tergite two separated by one and one-half times their transverse diameter; tergite five also with small, close punctures; anterior half of pygidial area irregularly rugose, the apical half granulate; first sternite with a median, longitudinal carina moderately elevated anteriorly and posteriorly, the profile of the carina thus broadly, roundly emarginate; second sternite with moderate, distinct separated punctures, except the posterior margin with fine, close punctures; sternites three to five with small to fine, close punctures at the posterior margin; hypopygium with small, dense punctures. *Legs* entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♀, AMBOINA (*F. Muir*), in University of Minnesota collection.

Related to *nereis* Kohl. Differs in having the pygidium longitudinally rugose only on the basal half, and the mesonotum not narrower than the posterior margin of the pronotum

Timulla (*Trogaspidia*) *cameroni* (Schulz).

Mutilla javanica Cameron, 1905, *Tijdschr. Ent.*, **48** : 48, ♀ (*nec* Dalle Torre).
Mutilla cameroni Schulz, 1906, *Spolia Hymenopt.* : 158, ♀.

Holotype of *javanica* Cameron.—♀, JAVA : Ardjuno (*Scheepmaker*), in Zoologisch Museum, Amsterdam.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *melmora* (Cameron).

Mutilla melmora Cameron, 1905, *Tijdschr. Ent.*, **48** : 49, ♀.

Holotype.—♀, JAVA: Ardjuno (*Scheepmaker*), in Zoologisch Museum, Amsterdam.

Distribution.—Known only from the type locality.

Closely related to *cameroni*, and may ultimately prove to be the same.

Timulla (*Trogaspidia*) *repraesentoides* Mickel.

Mutilla repraesentans Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 29, ♀ (*nec* Smith).
Timulla (*Trogaspidia*) *repraesentoides* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 411, ♀.
Timulla (*Trogaspidia*) *repraesentoides* Mickel, 1933, *Lingnan Sci. J.*, **12** : 309, ♀.

Holotype.—♀, FORMOSA: Hoozan, February, 1910 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—FORMOSA; and CHINA: Canton.

Timulla (*Trogaspidia*) *pentheus* (Smith).

Mutilla pentheus Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 116, ♀.
Mutilla pentheus Dalle Torre, 1897, *Cat. Hymen.*, **8** : 72, ♀.
Mutilla pentheus André, 1903, *Gen. Insect.*, **11** : 40, ♀.

Holotype.—♀, BACHIAN, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the unique type.

Timulla (*Trogaspidia*) *repraesentans* (Smith).

Mutilla repraesentans Smith, 1855, *Cat. Hymen. Brit. Mus.*, **3** : 35, ♀.

Holotype.—♀, INDIA, in British Museum (Natural History).

Distribution.—INDIA.

This species is included in the key because it has frequently been reported from the Pacific Islands erroneously. It is probably limited to a much smaller area than has been supposed. I have been unable to find a single specimen in the hundreds examined from the Pacific Islands which could be determined as this species.

Timulla (*Trogaspidia*) *taihorina taihorina* Mickel.

Mutilla subintrans Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 29, ♀ (*nec* Sichel & Radoskowski).
Timulla (*Trogaspidia*) *repraesentans taihorina* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 414, ♀.

Holotype.—♀, FORMOSA: Kankau (Koshun), April, 1912 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

A further study of *taihorina* has convinced me that it is not subspecifically related to *repraesentans*. In addition to its larger average size, the thorax is differently formed, *i.e.* humeral angles distinctly angulate, thorax broader at propodeal area than at pronotal area, and dorsum of thorax less convex, more flattened; the coxae and antennal tubercles are black; and the striae of the pygidium are slightly sinuate, instead of straight.

Timulla (Trogaspidia) taihorina nipponica subsp. n.

♀. Head, abdomen and legs entirely black, the thorax entirely ferruginous; second tergite with a pair of large, anterior, pale pubescent spots, the distance between the spots equal to the transverse diameter of one of them; both tergites three and four with broad, pale pubescent bands and both narrowly interrupted medially with black; pygidial area longitudinally striate, the striae slightly sinuate and not reaching the distal margin; humeral angles distinctly angulate; thorax distinctly broader at the propodeal area than at the pronotal area. Length, 9 mm.

Holotype.—♀, JAPAN (*F. Muir*), in University of Minnesota collection.

Exactly like subsp. *taihorina*, except the pale pubescent band on tergite three is narrowly interrupted medially instead of complete.

Timulla (*Trogaspidia*) *insidiator* (Smith).

Mutilla insidiator Smith, 1873, *Trans. ent. Soc. Lond.*, **1873** : 182, ♀.
Mutilla insidiator Smith, 1874, *Trans. ent. Soc. Lond.*, **1874** : 408, ♀.
Mutilla japonica Dalle Torre, 1897, *Cat. Hymen.*, **8** : 48, ♀ (*nec* Cameron).
Mutilla insidiator Dalle Torre, 1897, *Cat. Hymen.*, **8** : 50, ♀.
Mutilla insidiator, André, 1903, *Gen. Insect.*, **11** : 39, ♀.
Mutilla japonica André, 1903, *Gen. Insect.*, **11** : 39, ♀ (*nec* Cameron).
Mutilla insidiatrix Schulz, 1906, *Spolia Hymenopt.* : 158, ♀.
Mutilla insidiator Matsumura, 1931, *6000 Illust. Ins. Japan Empire* : 29, ♀.
Mutilla insidiator Esaki et alii, 1932, *Icon. Ins. Japon.* : 327, ♀.

Holotype.—♀, JAPAN : Hiogo, in British Museum (Natural History).

Distribution.—Known only from JAPAN.

It seems obvious that the descriptions of *insidiator* (1873) and (1874) are of the same species. Therefore *japonica* Dalle Torre falls as a synonym of *insidiator* (1873). See discussion of Smith's papers (1873, 1874) under *Squamulotilla ardescens* (Smith).

Timulla (*Trogaspidia*) *macassarica* (Zavattari).

Mutilla macassarica Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 80, ♀.

Holotype.—♀, CELEBES : Makassar, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

Easily recognised by the high, median, longitudinal keel on the second abdominal tergite.

The remainder and following males in this genus have the scutellum either convex or depressed but never with a median, longitudinal, glabrous, elevated line on the anterior half, which gives the scutellum more or less of a pyramidal appearance; in addition the hypopygium is simple and without lateral ridges. The females are not well known. In only one case (*celebensis*) are both sexes of a species correlated. It is possible that the females listed hereafter may be representatives of this group.

Timulla (*Trogaspidia*) *thoracica* (Smith).

Mutilla thoracica Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 76, ♂.
Mutilla thoracica Dalle Torre, 1897, *Cat. Hymen.*, **8** : 92, ♂.
——— *thoracica* André, 1903, *Gen. Insect.*, **11** : 71, ♂.

Holotype.—♂, CELEBES : Makassar, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

Timulla (Trogaspidia) saturnia saturnia nom. n.

Mutilla urania Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 83, ♂ (*nec* ♀).

Holotype.—♂, Malay Peninsula : Mt. Ophir (labelled as ♂ of *Odontomutilla urania* Smith), in Saunders' coll., Hope Dept. Oxford University.

Paratype.—♂, Malay Peninsula : Singapore.

Distribution.—Malay Peninsula. [See discussion of type locality under *Odontomutilla urania* (Smith).]

This is the ♂ attributed by Smith (1858) to the ♀ of his species *urania.* The ♂ is not congeneric with the ♀ *urania* and is obviously not the same species. The above name is proposed for this ♂.

Additional descriptive characters are : mandibles not excised beneath; first segment of flagellum only slightly shorter than the second; thorax ferruginous except only the thoracic sternum black; pale pubescent band of fourth tergite not extending to the lateral margins.

This and the following subspecies are the only forms in this section having a pale pubescent band on the fourth tergite and with the thorax ferruginous.

Timulla (Trogaspidia) saturnia samawangensis subsp. n.

♂. Head, abdomen, ventral half of mesopleurae and metapleurae, sides and posterior face of propodeum, and legs, all black, the remainder of the thorax ferruginous; posterior margin of second abdominal tergite with a thin fringe of pale pubescence; third and fourth tergites with a broad band of thick, appressed, pale pubescence, that on the fourth not extending to the lateral margins; mandibles not excised beneath; first segment of flagellum slightly but distinctly shorter than the second. Wings dark fuscous. Length, 15 mm.

Holotype.—♂, British N. Borneo; Samawang, near Sandakan, July 17, 1927 (*C. B. K.* and *H. M. P.*), in University of Minnesota collection.

Paratype.—♂, British N. Borneo : Kabayan, near Kinabalu, May 13, 1929 (*H. M. Pendlebury*).

Exactly like subsp. *saturnia*, except the black on the thorax considerably more extended.

Timulla (Trogaspidia) rubrocyanea sp. n.

♂. Head, thoracic sternum, and legs, black; remainder of thorax ferruginous; abdomen dark metallic blue; second abdominal tergite with a thick fringe, and third abdominal tergite with a broad band, of dense, appressed, pale pubescence; mandibles not at all excised beneath; first segment of flagellum only very slightly shorter than the second; seventh sternite and hypopygium, each with a pair of obscure, lateral tuberculiform areas, neither sternite ridged nor tuberculate. Wings dark fuscous. Length, 16 mm. *Head* black, the front and vertex with obscure bronze reflections, clothed with sparse, erect, obscure ferruginous pubescence, except the genae also with sparse, appressed, pale pubescence, and the lateral areas of clypeus with sparse, appressed, pale pubescence; mandibles slender, not excised beneath, edentate at the apex and with a distinct tooth within near the apex; median area of clypeus glabrous, impunctate, with a broad, low ridge on the posterior half, the anterior margin of clypeus very obscurely, shallowly emarginate medially; scape distinctly bicarinate beneath; first segment of flagellum almost equal in length to the second, only very slightly shorter; front, vertex and genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 4·7–5·6. *Thorax* ferruginous, except the sternum black; pronotum, mesonotum and scutellum with sparse, erect, ferruginous pubescence, the remainder with sparse, pale pubescence; pronotum, mesonotum and scutellum with large, dense, deep, confluent punctures; parapsidal furrows distinct on posterior half of mesonotum, the latter with a median, obscure, longitudinal ridge; scutellum very convex, almost hemispherical, but without a median, longitudinal raised line and not appearing pyramidal; dorsum and posterior face of propodeum rounded into one another, broadly and deeply reticulate; enclosed area of dorsum of propodeum subtriangular, the sides somewhat sinuate, the distal end slightly elevated to form a small tubercle; sides of propodeum separated from the dorsum and posterior face by a thin, crenulate ridge; anterior margin defined by a carina; propleurae shallowly, longitudinally rugose; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with moderately large, dense, confluent punctures, except the anterior fourth micropunctate and micropubescent; metapleurae micropunctate and micropubescent except moderate, shallow punctures ventrally; sides of propodeum shallowly reticulate throughout; tegulae ferruginous, glabrous, with scattered punctures and scattered ferruginous hairs. *Abdomen* dark metallic blue, the first three, and distal half of the last segment, with sparse, erect, pale, pubescence, segments four to six and the proximal half of the last, with sparse, erect, black pubescence, except the second tergite and sternite and the third sternite with a thick, apical fringe of appressed, pale pubescence, and the third tergite with a broad, complete band of dense, appressed, pale pubescence; first tergite with moderately large, close punctures except at the distal margin the punctures moderate to small; second tergite with moderate punctures, sparse on the disk and postero-medial area, close anteriorly and dense, almost confluent laterally; anterior half of segments three to six, each with small, separated punctures, the posterior half of each finely punctate; last tergite with small punctures, sparse along the mid-longitudinal line, distinct but sometimes close elsewhere; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite conspicuously gibbose slightly anterior to the middle, with moderately large punctures, sparse medially, becoming dense and confluent laterally; sternites three to six with moderate, close but distinct punctures posteriorly; seventh sternite and hypopygium with obscurely elevated areas as described above. *Wings* dark fuscous, except the proximal third pale; cell 2nd $R_1 + R_2$ subtruncate at the apex, one and one-third times as long as cell R + 1st R_1; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but much less distinct than R_5 and receiving vein M_2 at the middle; vein *m-cu* terminating anterior to vein $M_4 + Cu_1$ by half the length of the latter. *Legs* black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, British N. Borneo: Bettotan, near Sandakan, August 20, 1927 (*C. B. K.* and *H. M. P.*), in University of Minnesota collection.

Paratypes.—♂, British N. Borneo: Bettotan, near Sandakan, August 18, 1927 (*C. B. K.* and *H. M. P.*); ♂, British N. Borneo: Bettotan, near Sandakan (*C. B. K.* and *H. M. P.*).

Easily recognisable by the metallic blue abdomen and non-excised mandibles.

Timulla (*Trogaspidia*) *bonthainensis* (André).

Mutilla bonthainensis André, 1896, *Termes. Fuzetek*, **19**: 14, ♂.
Mutilla bonthainensis André, 1903, *Gen. Insect.*, **11**: 38, ♂.
?*Mutilla bonthainensis* Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 96, ♂.

Holotype.—♂, Celebes: Bonthain, in Hungarian National Museum.

I have not seen the specimens recorded by Zavattari (1913) and considering their size and the locality where they were collected it is possible they are not the same.

Timulla (*Trogaspidia*) *rapa* (Zavattari).

Mutilla rapa Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3): 36, ♂.
Timulla (*Trogaspidia*) *rapa* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26**: 408, ♂.

Holotype.—♂, Formosa: Tiahorin, October, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *stella* (Zavattari).

Mutilla stella Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 96, ♂.

Holotype.—♂, SUMATRA : Marang, in Museo Civico di Storia naturale, Genoa.
Distribution.—Known only from the type locality.

Timulla (Trogaspidia) hylonome sp. n.

♂. Head, abdomen and legs black, the thorax entirely ferruginous; apical margin of second tergite with a thin fringe of pale pubescence, the third tergite with a broad band of thick, appressed, pale pubescence; mandibles excised beneath forming a tooth beneath near the base; first segment of flagellum much shorter than the second, only about half the length of the second. Wings dark fuscous. Length, 12 mm. *Head* entirely black, clothed with sparse, erect, obscure ferruginous pubescence, the front and genae also with sparse, appressed, pale pubescence, the lateral areas of clypeus with dense, appressed, pale pubescence; mandibles as above; median area of clypeus glabrous, impunctate except for three setiferous punctures anteriorly; scape broadened and flattened distally with only a single well-developed carina beneath; flagellum as above, except the first segment beneath, and a spot on the base of the second segment beneath, yellowish; antennal scrobes carinate above; front, vertex and genae with moderate punctures, dense and confluent on the front, close but mostly distinct on the vertex, separated and shallow on the genae; relative widths of head and thorax at the tegulae, 3·9–4·1. *Thorax* entirely ferruginous, clothed throughout with sparse, pale ferruginous pubescence, the mesopleurae and dorsum of propodeum also with obscure, appressed, pale pubescence; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures; parapsidal furrows distinct on posterior two-thirds of mesonotum; dorsum and posterior face of propodeum rounded into one another, broadly, distinctly reticulate; enclosed space of dorsum of propodeum subtriangular, the sides sinuate; anterior margin of propleurae defined by a carina; propleurae obscurely, longitudinally rugose, micropunctate and micropubescent; ventral and dorsal areas of mesopleurae elevated, the two separated by a furrow, with moderately large, dense, confluent punctures, except anteriorly the punctures sparse and the surface micropunctate and micropubescent, except for moderate, close punctures ventrally; sides of propodeum rounded into the dorsum and posterior face, reticulate, except anteriorly micropunctate and micropubescent. *Abdomen* entirely black, the first three segments clothed with sparse, erect, pale pubescence, the remainder with sparse, erect, black pubescence, except the apical margin of the second with a thin fringe of pale pubescence, and the third with a broad, complete band of dense, appressed, pale pubescence; first tergite with moderate, scattered punctures, except at the apical margin with sparse, small punctures; second tergite with moderately small punctures, scattered medially and posteriorly, sparse to well separated laterally; tergites three to six with small punctures, close but distinct anteriorly on each tergite, sparse posteriorly on each; last tergite with a median, elongate, glabrous, impunctate area, elsewhere with moderately small, close punctures; first sternite with a prominent, median, longitudinal carina on the anterior two-thirds; second sternite with sparse, moderately small punctures; sternites three to six with moderately small, close punctures posteriorly; hypopygium with moderately small, close punctures. *Wings* dark fuscous; cell 2nd $R_1 + R_2$ subtruncate at the apex, about one and one-third times as long as cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at two-thirds the distance from base to apex; cell R_4 almost obsolete, receiving vein M_2 distinctly beyond the middle; vein *m-cu* terminating anterior to vein $M_4 + Cu_1$ by about half the length of the atter. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, BORNEO: Sandakan (*Baker*), Cat. no. 50040 United States National Museum.

Paratypes.—5 ♂♂, BORNEO: Sandakan (*Baker*); 2 ♂♂, BORNEO: Bettotan, near Sandakan, August 17–18, 1927 (*C. B. K.* and *H. M. P.*).

The excised mandibles, short first flagellar segment, and entirely ferruginous thorax distinguish this species.

Timulla (*Trogaspidia*) *sumatrensis* (André).

Mutilla sumatrensis André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 79, ♂.
Mutilla sumatrensis André, 1903, *Gen. Insect.*, **11** : 41, ♂.

Holotype.—♂, SUMATRA: Si-Rambé, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

Timulla (Trogaspidia) nedyme sp. n.

♂. Head, abdomen and legs black, the thorax entirely ferruginous; none of the abdominal tergites with bands of appressed, pale pubescence; mandibles not excised beneath; first segment of flagellum slightly but distinctly longer than the second. Wings fuscous. Length, 13 mm. *Head* entirely black, except the antennal tubercles ferruginous, clothed with sparse, erect, pale pubescence, the anterior area of the front, and the genae, also with sparse, appressed, pale pubescence, the lateral areas of clypeus with dense, appressed, pale pubescence; mandibles not excised beneath, slender, edentate at the apex and with a distinct tooth within near the apex; median area of clypeus glabrous, the lateral and posterior margins finely punctate and finely, pale pubescent, medially obscurely bituberculate, the tubercular elevations low and not distinct; scape distinctly bicarinate beneath; first segment of flagellum slightly but distinctly longer than the second; antennal scrobes carinate above; front, vertex and genae with moderately large, dense, confluent punctures; relative widths of head and thorax at the tegulae, 4·6–5·2. *Thorax* entirely ferruginous, except a large black spot on the posterior face of propodeum; pronotum, mesonotum and scutellum with sparse, erect, ferruginous pubescence, elsewhere with similar pale pubescence, except the dorsum of propodeum with sparse, appressed, pale pubescence, and the mesopleurae with somewhat thick, appressed, pale pubescence; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures; parapsidal furrows distinct on posterior half of mesonotum; scutellum convex; dorsum and posterior face of propodeum rounded into one another, broadly, distinctly reticulate; enclosed space of dorsum of propodeum not well defined, similar to the surrounding reticulations; anterior margin of propleurae defined by a carina; propleurae, anterior and posterior margins of mesopleurae, and metapleurae, micropunctate and micropubescent, except the latter with moderate, indistinct punctures ventrally; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with large, dense, confluent punctures; posterior half of sides of propodeum shallowly, narrowly reticulate, the anterior half micropunctate and micropubescent; tegulae ferruginous, glabrous, the disk impunctate, elsewhere more or less finely punctate and ferruginous pubescent. *Abdomen* black, the first three segments, the fourth tergite entirely, and the fifth except the apical margin, with sparse, erect, pale pubescence; remainder of abdomen with sparse, black pubescence; first tergite with small to moderate punctures, scattered medially, somewhat close laterally; second tergite with small, scattered punctures medially and posteriorly, moderate, closer punctures laterally; tergites three to six with sparse, small punctures, except each at the sides with the punctures somewhat closer and larger, more conspicuously so on tergites three and four; last tergite with a median, elongate, glabrous area, elsewhere with moderate, close punctures; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite slightly gibbose anteriorly, with scattered, moderately small punctures; sternites three to six with moderately small, sparse punctures; hypopygium with small, well-separated punctures. *Wings* fuscous throughout; cell 2nd $R_1 + R_2$ truncate at the apex, one and one-third times as long as cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at three-fifths the distance from base to apex; cell R_4 present but indistinct and receiving the indistinct vein M_2 slightly beyond the middle; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50041 United States National Museum.

Paratypes.— 2 ♂♂, Borneo: Sandakan (*Baker*); ♂, Borneo: Bettotan, near Sandakan, August 20, 1927 (*C. B. K.* and *H. M. P.*).

Two of the paratypes have the mesopleurae and sides of propodeum infuscated.

Timulla (Trogaspidia) spatale sp. n.

♂. Head, thorax, legs, anterior two-thirds of first abdominal segment, and last five abdominal segments, black, the posterior third of the first abdominal segment, and the second entirely, ferruginous; mandibles not at all excised beneath; first segment of flagellum slightly but distinctly longer than the second; scutellum moderately convex, not at all gibbose or pyrimidal. Wings fuscous. Length, 14 mm.? *Head* entirely black, clothed with sparse, erect, pale pubescence, except the genae with sparse, appressed, pale pubescence, and the lateral areas of clypeus with dense, appressed, pale pubescence; mandibles not at all excised beneath, slender, edentate at the apex and with a small tooth within near the apex; median area of clypeus glabrous, mostly bare, with a concave, semicircular area at the anterior margin, the area defined posteriorly by a low semicircular ridge; scape distinctly bicarinate beneath; flagellum as above; antennal scrobes carinate above; front, vertex and genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 4·4–5·0. *Thorax* entirely black, sparsely clothed with pale, erect pubescence, except the dorsum of propodeum and mesopleurae also with sparse, appressed, pale pubescence, and the mesonotum and scutellum with sparse, erect, black pubescence; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures, densest on the scutellum; parapsidal furrows distinct and deep on the posterior half of mesonotum; scutellum as above; dorsum and posterior face of propodeum rounded into one another, broadly, distinctly reticulate; enclosed space of dorsum of propodeum elongate, narrow, the sides subparallel, not elevated distally; anterior margin of propleurae defined by an obscure carina; propleurae, anterior and posterior margins of mesopleurae, metapleurae except for moderate punctures ventrally, and anterior third of sides of propodeum, all micropunctate and microreticulate; ventral and dorsal areas of mesopleurae elevated, the two areas separated by a furrow, with moderate, dense, confluent punctures; posterior two-thirds of sides of propodeum shallowly reticulate; tegulae faintly microreticulate, impunctate, except the anterior and inner margins punctate and fuscous pubescent. Posterior third of first, and the second *abdominal segment*, ferruginous, the remainder of the abdomen entirely black (abdominal segments four to seven of holotype missing, but since three is black, undoubtedly the remainder are black also); first tergite with scattered, moderately small punctures, except the posterior margin with sparse, small punctures; second tergite with a transverse, angulate ridge separating the anterior two-thirds and the posterior third; anterior to the ridge the second tergite medially with very sparse, small punctures, laterally and anteriorly with sparse, moderately small punctures; posterior to the ridge with scattered, small punctures medially, sparse, moderately small punctures laterally; third tergite impunctate along the median, longitudinal line, with sparse, moderately small punctures elsewhere, closer laterally than medially (segments four to seven missing in holotype); first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite distinctly gibbose at the anterior middle, with sparse, moderate punctures; sternite three with somewhat close, moderate punctures. *Wings* fuscous throughout; cell 2nd $R_1 + R_2$ obscurely truncate at the apex, one and one-third times the length of cell $R +$ 1st R_1; cell R_5 receiving vein M_{3+4} at almost two-thirds the distance from base to apex; cell R_4 almost obsolete, receiving the almost obsolete vein M_2 at the middle. *Legs* black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, BORNEO : Samawang, near Sandakan, July 15, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Related to *nedyme*; the first flagellar segment and non-excised mandibles are the same as in that species; differs in colour and in the form of the clypeus.

Timulla (*Trogaspidia*) *olbia* (Cameron).

Mutilla olbia Cameron, 1902, *J. Straits Br. R. Asiatic Soc.*, **37** : 75, ♂.

Holotype.—♂, BORNEO : Penrissen, Sarawak, in British Museum (Natural History).

Specimens examined.—♂, BORNEO : Mattang, June.

Distribution.—Known only from BORNEO.

Timulla (Trogaspidia) dercetis sp. n.

♂. Head, thorax, legs, posterior half of third abdominal segment, and abdominal segments four to seven, black, the first two abdominal segments and the anterior half of the third, ferruginous; first five abdominal segments clothed with sparse, erect, pale pubescence, the last two with sparse, black pubescence; mandibles deeply excised beneath; first segment of flagellum about three-fifths the length of the second, tinged with yellow beneath; scutellum only moderately convex; second sternite distinctly gibbose at the middle anteriorly. Wings dark fuscous. Length, 13 mm. *Head* entirely black, except the first segment of flagellum beneath slightly tinged with yellow, clothed with sparse, erect, pale pubescence, the anterior portion of front and the genae also with sparse, appressed, pale pubescence; lateral areas and medio-posterior area of clypeus with thick, appressed, pale pubescence; mandibles deeply excised beneath forming a prominent tooth beneath near the base, edentate at the apex and with a distinct tooth within near the apex; median area of clypeus with a depressed, semicircular, glabrous area at the anterior margin, the posterior margin of the area defined by a semicircular ridge; posterior area of clypeus behind the ridge shallowly, transversely concave; scape distinctly bicarinate beneath; first segment of flagellum as described above; antennal scrobes obscurely carinate above; front, vertex and genae with moderately large punctures, those on the front dense and confluent, on the vertex and genae close and distinct; relative widths of head and thorax at the tegulae, 4·5–5·0. *Thorax* entirely black, clothed with sparse, pale pubescence, except the mesonotum and scutellum with sparse, black pubescence, and the mesopleurae also with thick, appressed, pale pubescence; pronotum, mesonotum and scutellum with moderately large punctures, dense and confluent on the pronotum, close and distinct on the mesonotum and scutellum; parapsidal furrows distinct on the posterior half of mesonotum; scutellum only moderately convex; dorsum, posterior face, and sides of propodeum all rounded into one another, the dorsum and posterior face broadly distinctly reticulate; enclosed space of dorsum of propodeum elongate, the sides sinuate, the distal end not elevated; anterior margin of propleurae defined by a carina; propleurae obscurely rugoso-punctate; ventral and dorsal areas of mesopleurae moderately elevated, the two areas separated by a furrow, with moderate, dense, confluent punctures, except the broad, anterior margin micropunctate and micropubescent; metapleurae micropunctate and micropubescent except for sparse, moderate punctures ventrally; sides of propodeum shallowly, broadly reticulate except a narrow, anterior margin micropunctate and micropubescent; tegulae large, black, elongate, extending one-third their length beyond the posterior margin of the mesonotum, glabrous, impunctate, except the anterior and inner margins punctate and dark pubescent. First two *abdominal segments* and anterior half of third ferruginous, the posterior half of third and remaining segments black, the first five segments sparsely clothed with pale pubescence, the remaining segments with sparse, black pubescence; first tergite with moderately large, close punctures, except the posterior margin with sparse, small punctures; second tergite with a prominent, transverse, angular ridge separating the anterior two-thirds and the posterior third; anterior to the ridge with moderate punctures, sparse medially, close laterally; posterior to the ridge with scattered, small punctures; tergites three to six with sparse, small punctures the latter becoming close laterally; last tergite with a median, elongate, glabrous, slightly tumescent area; lateral areas of last tergite with small, close punctures; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite distinctly gibbose anteriorly at the middle, with moderately large punctures, sparse medially, close at the sides; sternites three to six with moderate, sparse punctures; hypopygium with small, close, shallow punctures. *Wings* fuscous throughout; cell 2nd $R_1 + R_2$ obliquely truncate at the tip, one and one-third times the length of $R +$ 1st R_1; cell R_5 receiving vein M_{3+4} two-thirds the distance from base to apex; cell R_4 present but indistinct and receiving the indistinct vein M_2 two-thirds the distance from base to apex; vein *m-cu* terminating anterior to vein $M_4 + Cu_1$ by about one-half the length of the latter. *Legs* black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, BRITISH N. BORNEO: Bettotan, near Sandakan, August 20, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratypes.—4 ♂♂, BRITISH N. BORNEO: Bettotan, near Sandakan, August 7, 8, 12 and 18, 1927 (*C. B. K.* and *H. M. P.*); 2 ♂♂, BORNEO: Kuching, Sarawak, May 25, 1900 (*Dyak*).

Closely related to *olbia* Cameron, but differs most conspicuously in the form of the second abdominal segment, the latter being gibbose ventrally and having the transverse angulate ridge prominent on the dorsum. In *olbia* the same segment is evenly convex ventrally and the dorsal ridge is obscure; in *dercetis* the first flagellar segment is tinged with yellow beneath while in *olbia* the same segment is entirely black.

Timulla (*Trogaspidia*) *sticticornis sticticornis* Mickel.

Timulla (*Trogaspidia*) *sticticornis sticticornis* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 186, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Kolambugan, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS: islands of Samar and Mindanao.

Timulla (*Trogaspidia*) *sticticornis nigridia* Mickel.

Timulla (*Trogaspidia*) *sticticornis nigridia* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 188, ♂.

Holotype.—♂, PHILIPPINE ISLANDS: Iligan, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS: Mindanao.

Timulla (*Trogaspidia*) *fortuita fortuita* Mickel.

Timulla (*Trogaspidia*) *fortuita* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 181, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Tangcolan, Mindanao (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Sibuyan, Negros, Mindanao, Basilan and Palawan.

Timulla (Trogaspidia) fortuita nebulosa subsp. n.

♂. Head, thorax, last five abdominal segments and legs, black, the first two abdominal segments, ferruginous; scape with a single well-developed carina, the anterior one almost obsolete; vertex with fine, sparse punctures; pronotum with moderate, dense, confluent punctures; second abdominal segment with very sparse, fine punctures. Wings fuscous. Length, 10 mm.

Holotype.—♂, BORNEO : Sandakan (*Baker*), Cat. no. 50042 United States National Museum.

Paratypes.—17 ♂♂, BORNEO : Sandakan (*Baker*); 8 ♂♂, BORNEO : Bettotan, near Sandakan, August 4–21, 1927, ♂, BORNEO : Samawang, near Sandakan, July 9, 1927, 4 ♂♂, BORNEO : Kudat, September 7–18, 1927 (all *C. B. K.* and *H. M. P.*); 2 ♂♂, BORNEO : Kuching, Sarawak, September 28, and December 23, 1899 (*Dyak*).

This subspecies differs from subsp. *fortuita* in the colour of the wings and puncturation of vertex and pronotum. The first segment of the flagellum is obscurely tinged with yellow in some specimens; in the larger specimens the vertex may be said to have sparse, small punctures, rather than fine punctures; some specimens have the third abdominal segment in part or entirely ferruginous. The paratypes vary in length from 8 to 12 mm. The puncturation of the second abdominal segment and the form of the clypeus is exactly like that of subsp. *fortuita.*

Timulla (*Trogaspidia*) *temeraria* Mickel.

Timulla (*Trogaspidia*) *temeraria* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 179, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Known only from PHILIPPINE ISLANDS : Luzon.

Timulla (*Trogaspidia*) *bagrada* (Cameron).

Mutilla bagrada Cameron, 1902, *J. Straits Br. R. Asiatic Soc.*, **37** : 76, ♂.

Holotype.—♂, BORNEO : Kuching, Sarawak, in British Museum (Natural History).

Specimens examined.—♂, SARAWAK : Kuching.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *nallinia* (Zavattari).

Mutilla nallinia Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 100, ♂.

Type.—♂, JAVA, in Zoological Museum, University of Torino.

Specimens examined.—♂, JAVA : Tjibodas, December, 1908 (*Terry*).

Distribution.—Known only from JAVA.

Timulla (Trogaspidia) depressicornis sp. n.

♂. Head, thorax, last four abdominal segments, and legs, black, the first three abdominal segments ferruginous; first five abdominal segments clothed with sparse, erect, pale pubescence, the last two with sparse, black pubescence; first segment of flagellum about one and one-fourth times as long as the second, conspicuously flattened and broadened on the proximal half; distal half of first flagellar segment beneath, and segments two to four entirely beneath, pale ferruginous; scutellum strongly convex; hypopygium simple, unarmed; tegulae microreticulate. Wings fuscous. Length, 15 mm. *Head* entirely black, except the flagellum as described above, clothed with sparse, erect, pale pubescence, except the genae and anterior half of front with sparse, appressed, pale pubescence; clypeus with thick, pale pubescence; mandibles robust, deeply excised beneath forming a tooth near the base beneath, edentate at the apex, and with two distinct teeth within near the apex; anterior third of clypeus medially somewhat concave, bare, elsewhere with thick, pale pubescence; scape distinctly bicarinate beneath; flagellum as above; antennal scrobes carinate above; front, vertex and genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 5·3–5·9. *Thorax* entirely black, clothed with sparse, erect, pale pubescence, except the mesonotum with sparse, black pubescence, and the pronotal, propodeal and pleural areas also with sparse, appressed, pale pubescence, the latter forming a pale band at the posterior margin of pronotum, and somewhat thick on mesopleurae; pronotum, mesonotum and scutellum with moderately large punctures, dense and confluent on the pronotum and scutellum, close but mostly distinct on the mesonotum; parapsidal furrows distinct and deep on posterior half of mesonotum; scutellum very convex but not pyramidal; dorsum and posterior face of propodeum rounded into one another, broadly, distinctly reticulate; enclosed area of dorsum of propodeum elongate and subrectangular; anterior margin of propleurae defined by an indistinct carina; propleurae micropunctate and micropubescent, with a few, scattered, moderate punctures; ventral and dorsal areas of mesopleurae moderately elevated, the two areas separated by a shallow furrow, with moderately large, dense, shallow, confluent punctures, except the anterior and posterior margins micropunctate; metapleurae micropunctate except ventrally with moderate punctures; posterior half of sides of propodeum narrowly, shallowly reticulate, the anterior half micropunctate; tegulae large, microreticulate, bare, except the anterior and inner margins punctate and pale fuscous pubescent. First three *abdominal segments* ferruginous, the remainder of the abdomen, black; first five abdominal segments clothed with sparse, erect, pale pubescence, the last two segments with sparse, black pubescence; first tergite with scattered, small punctures; second tergite with the disk and postero-medial area finely, scatteringly punctate, anteriorly and laterally with small, sparse punctures becoming moderate and distinct towards the lateral margins; tergites three to six with small, sparse punctures, the latter slightly larger and closer towards the lateral margins; last tergite with a low, obscure, median, longitudinal, glabrous ridge, the lateral areas with small to moderate, distinct punctures; first sternite with a median, longitudinal carina on the anterior half; second sternite distinctly gibbose at the anterior middle, with sparse, moderate punctures; sternites three to six with sparse, moderate punctures; hypopygium with close, distinct, moderate punctures. *Wings* fuscous throughout; cell 2nd $R_1 + R_2$ truncate at the apex, almost one and one-half times as long as cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at three-fifths the distance from base to apex; cell R_4 present but indistinct and receiving the indistinct vein M_2 at three-fifths the distance from base to apex; vein *m-cu* terminating distinctly anterior to vein $M_4 + Cu_1$. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50043 United States National Museum.

Paratypes.—2 ♂♂, Borneo: Bettotan, near Sandakan, August 19 and 22, 1927 (*C. B. K.* and *H. M. P.*); ♂, Borneo: Kuching, Sarawak, May 25, 1900 (*Dyak*).

Related to *nallinia* Zavattari, but differs as stated in key as well as in puncturation, *nallinia* having the head and thorax in general more densely punctured.

Timulla (*Trogaspidia*) *ira ira* (Cameron).

Mutilla ira Cameron, 1902, *J. Straits Br. R. Asiatic Soc.*, **37** : 74, ♂.
Mutilla attila Cameron, 1903, *J. Straits Br. R. Asiatic Soc.*, **39** : 152, ♂.

Holotype.—♂, Borneo: Sarawak, in British Museum (Natural History). Type of *attila* Cameron also in British Museum (Natural History).

Specimens examined.—18 ♂♂, Borneo: Sandakan (*Baker*); 13 ♂♂, Borneo: Bettotan, near Sandakan, July 30–August 22 (*C. B. K.* and *H. M. P.*); 2 ♂♂, Borneo: Kudat, September 15 and 18, 1927 (*C. B. K.* and *H. M. P.*); ♂, Borneo: Kuching, Sarawak, August 14, 1899 (*Dyak*).

Distribution.—Borneo.

Sandakan specimens were compared with the holotype of *ira*. The holotypes of *ira* and *attila* were compared and found to be identical.

Timulla (*Trogaspidia*) *ira palawana* Mickel.

Timulla (*Trogaspidia*) *ira palawana* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 177, ♂.

Holotype.—♂, Philippine Islands: Port Princesa, Palawan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *neglecta* (Smith).

Mutilla neglecta Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 76, ♂.
Mutilla neglecta Dalle Torre, 1897, *Cat. Hymen.*, **8** : 65, ♂.
——— *neglecta* André, 1903, *Gen. Insect.*, **11** : 71, ♂.
Mutilla neglecta Schulz 1906, *Spolia Hymenopt.* : 157, ♂.
Mutilla neglecta Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 86, ♂.

Holotype.—♂, Celebes: Makassar, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Celebes.

Zavattari (1913) records this species from Celebes: Minahassa. I have not examined the specimens, but the additional description which he gives indicates that his determination is correct.

Timulla (*Trogaspidia*) *gutrunae* (Zavattari).

Mutilla gutrunae Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 34, ♂.
Timulla (*Trogaspidia*) *gutrunae* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 410, ♂.

Lectotype.—♂, Formosa: Taihorin, July, 1911 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from Formosa.

Timulla (*Trogaspidia*) *nigerrima* Mickel.

Timulla (*Trogaspidia*) *nigerrima* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 184, ♂.

Holotype.—♂, Philippine Islands: Malinao, Tayabas Province, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS: islands of Luzon, Samar, Biliran and Mindanao.

Timulla (*Trogaspidia*) *friekae friekae* (Zavattari).

Mutilla friekae Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 35, ♂.
Timulla (*Trogaspidia*) *friekae* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 410, ♂.

Lectotype.—♂, FORMOSA (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *friekae discrepans* Mickel.

Timulla (*Trogaspidia*) *friekae discrepans* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 410, ♂.

Holotype.—♂, FORMOSA: Taihorinsho, September, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *volatilis* (Smith).

Mutilla volatilis Smith, 1859, *J. Proc. linn. Soc., Zool.*, **3** : 9, ♂.
Mutilla maura Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 75, ♂ (*nec* L.).
Mutilla mariae Dalle Torre, 1897, *Cat. Hymen.*, **8** : 57, ♂.
Mutilla volatilis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 98, ♂.
Mutilla volatilis André, 1903, *Gen. Insect.*, **11** : 41, ♂.
——— *maura* André, 1903, *Gen. Insect.*, **11** : 71, ♂ (*nec* L.).
Mutilla maura Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 90, ♂ (*nec* L.).

Holotype.—♂, CELEBES, in Saunders' coll., Hope Dept. Oxford University. The type of *maura* is in the same collection.

I have compared the types of *volatilis* and *maura* and find them to be identical. I have not seen Zavattari's specimens (1913), but apparently they are the same as Smith's *volatilis.*

Timulla (*Trogaspidia*) *celebensis* (André).

Mutilla celebensis André, 1905, *Z. Hymen. Dipt.*, **5** : 215, 265, ♂ and ♀.

Holotype and allotype.—♂ and ♀, SOUTH CELEBES: Bui-Kraeng, in the Hungarian National Museum, Budapest.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *orientalis orientalis* Mickel.

Mutilla dimidiata Lepeletier, 1845, *Hist. nat. Ins., Hymen.*, **3** : 628, ♂ (*nec* Latreille, 1792).
Mutilla dimidiata Zavattari, 1910, *Ann. Mus. zool. Univ. Napoli*, (3) **9** : 9, ♂.
Timulla (*Trogaspidia*) *orientalis* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 377, ♂.

Lectotype.—♂, INDO-ORIENTALE, labelled " *Mutilla dimidiata* Lep., typus. Coll. Serville," in Spinola collection, Zoological Museum, University of Torino.

Distribution.—Known only from INDIA.

Included in key on account of previous incorrect records. Matsumura (1931) has recorded this species from Formosa under the name *dimidiata* Lepeletier. This species does not occur in Formosa as I have pointed out (1933). It is impossible to say from the brief descriptive notes accompanying the figure what species is referred to in Matsumura's illustrated volume on Japanese insects.

Timulla (*Trogaspidia*) *orientalis taiwanensis* Mickel.

Mutilla dimidiata Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 42, ♂ (*nec* Lepeletier).
Mutilla gribodoi Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 42, ♂ (in part).
Timulla (*Trogaspidia*) *orientalis taiwanensis* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 408, ♂.

Holotype.—♂, FORMOSA : Taihanroku, August 3–10, 1908 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *kellyi* (Pagden).

Smicromyrme kellyi Pagden, 1934, *J. F.M.S. Mus.*, **17** : 439, figs. 12–14, ♂ (*nec* ♀).

Holotype.—♂, KEDAH : (unfederated Malay States), Bukit Panchor, July 10, 1929, in British Museum (Natural History).

Distribution.—MALAY PENINSULA.

Paratypes of both sexes have been examined. The female is a *Smicromyrme*, but the male belongs to that section of the subgenus *Trogaspidia* in which the scutellum is not elevated and the hypopygium is without elevated ridges. The original description does not indicate that the two sexes were taken *in copula*, but only that they were taken at the same time and place, so it is probable that they do not represent the two sexes of the same species. *T. kellyi* is closely related to *orientalis orientalis* Mickel, but differs in having the median tubercle at the posterior margin of the clypeus very small, and in the black terminal segments of the abdomen.

Timulla (*Trogaspidia*) *circumcincta* (André).

Mutilla circumcincta André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 71, ♀.
Mutilla circumcincta André, 1903, *Gen. Insect.*, **11** : 38, ♀.
Mutilla circumcincta André, 1905, *Z. Hymen. Dipt.*, **5** : 212, ♂ and ♀.
Timulla (*Trogaspidia*) *circumcincta* Mickel, 1933, *Lingnan Sci. J.*, **12** : 314, ♀.

Lectotype.—♀, SUMATRA : Balighe (*E. Modigliani*), in Museo Civico di Storia naturale, Genoa.

Distribution.—SUMATRA; MALAY PENINSULA; CHINA : Canton.

Timulla (*Trogaspidia*) *logei* (Zavattari).

Mutilla logei Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 30, ♀.
Timulla (*Trogaspidia*) *logei* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 413, ♀.

Lectotype.—♀, FORMOSA : Hoozan, February, 1910 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *dohertyi* (Zavattari).

Mutilla dohertyi Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 78, ♀.

Holotype.—♀, SUMBAWA, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *pfafneri* (Zavattari).

Mutilla pfafneri Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 30, ♀.
Timulla (*Trogaspidia*) *pfafneri* Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 413, ♀.

Lectotype.—♀, FORMOSA : Taihorin, March, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Timulla (*Trogaspidia*) *mamblia* (Cameron).

Mutilla mamblia Cameron, 1902, *J. Straits Br. R. Asiatic Soc.*, **37** : 79, ♀.

Holotype.—♀, BORNEO : Kuching, Sarawak, in British Museum (Natural History).

Distribution.—Known only from the type locality.

I have not examined the specimens recorded by Zavattari (1913) from MALAY PENINSULA : Perak, but doubt that the specimens really belong to Cameron's species.

Timulla (Trogaspidia) psecas sp. n.

♀. Head and abdomen, black; antennal tubercles, scape, pedicel, flagellum more or less beneath, thorax entirely, legs except the fuscous tarsi, all ferruginous; genae with moderate, dense, confluent punctures; second abdominal tergite with a pair of anterior, subcircular, pale pubescent spots separated by slightly more than their own diameter; third tergite with a broad, complete band of dense, appressed, pale pubescence; pygidial area entirely glabrous, unsculptured. Length, 8 mm. *Head* black, except the proximal two-thirds of mandibles, antennal tubercles, scape, pedicel, and flagellum tinged beneath, ferruginous, clothed with sparse, erect, fuscous pubescence, the genae also with sparse, short, appressed, fuscous pubescence; mandibles slender, edentate at the apex and with a small tooth within near the apex; clypeus elevated posteriorly, the elevated margin subarcuate; a median, small tubercle just posterior to the elevated margin, the area anterior to the latter glabrous; scape finely punctate; first segment of flagellum a little less than twice as long as the second; antennal scrobes distinctly carinate above; front, vertex and genae with moderate, dense, confluent punctures throughout; posterior margin of genae defined by a carina; relative widths of head and thorax, 3·5–3·1. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect, ferruginous pubescence, the posterior face of propodeum with sparse, erect, pale pubescence, and all the pleural areas including the sides of propodeum micropunctate and pale micropubescent; dorsum of thorax with moderately large, dense, deep, confluent punctures; humeral angles distinctly angulate; lateral margins of pronotum diverging posteriorly to a distinct, small tooth slightly posterior to the middle then slightly converging; lateral margins of mesonotum crenulate, slightly converging posteriorly; scutellar scale present; deep punctures of dorsum extending on to dorsum of propodeum and becoming subreticulate on anterior half of posterior face of propodeum; lateral margins of dorsum and posterior face of propodeum denticulate; relative widths of thorax at humeral angles, tooth on lateral margins of pronotum, anterior spiracles, posterior spiracles, and greatest width of propodeum, 2·6–3·1–2·8–2·6–2·8; anterior margin of propleurae defined by a weak but distinct carina. *Abdomen* black, except the first sternite somewhat ferruginous, clothed with sparse, erect, pale pubescence, except the median two-thirds of second tergite and tergites four and five with sparse, erect, fuscous pubescence, the second tergite with a pair of pale pubescent spots and the third tergite with a pale pubescent band as described above; first tergite with sparse, moderate punctures except the posterior and lateral margins with close, moderately small punctures; second tergite with moderate to moderately large, dense, deep, distinct punctures, the lateral fifths with the punctures less deep and slightly more separated, and the remainder very finely, closely punctate in addition to the deep, moderate punctures; tergites three to five each with small, close punctures proximally, finely punctate elsewhere; last tergite with small, close punctures, except the well-defined pygidial area glabrous, unsculptured; first sternite with a median, longitudinal carina on the anterior two-thirds; second sternite with sparse, moderate punctures, the latter somewhat closer laterally than medially; sternites three to five with small, close punctures posteriorly; hypopygium with small, close punctures; sternites two to four with a narrow band of fine, thick, pale pubescence at the distal margin. *Legs* ferruginous, except the tarsi fuscous, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♀, Borneo : Sandakan (*Baker*), Cat. no. 50044 United States National Museum.

Paratypes.—12 ♀♀, Borneo : Sandakan (*Baker*); ♀, Borneo : Bettotan, near Sandakan, August 14, 1927 (*C. B. K.* and *H. M. P.*); ♀, Borneo : Samawang, near Sandakan, July 11, 1927 (*C. B. K.* and *H. M. P.*); ♀, Borneo : Kabayan, near Kinabalu, May 12, 1929 (*H. M. Pendlebury*); ♀, W. Borneo : Mowong, September, 1907 (*F. Muir*).

Related to both *boopis* Kohl and *proserpina proserpina* Smith. Differs from both principally in having the genae distinctly more coarsely punctate. It averages larger in size than subsp. *proserpina* and also differs from the latter in having the first tergite black instead of ferruginous; the tooth on the lateral margins of the pronotum is also more strongly developed than in subsp. *proserpina.*

Timulla (*Trogaspidia*) *boopis* (Kohl).

Mutilla boopis Kohl, 1882, *Verh. zool.-bot. Ges. Wien*, **32** : 478, pl. 32, fig. 5, ♀.
Mutilla boopis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 17, ♀.
Mutilla boopis André, 1903, *Gen. Insect.*, **11** : 38, ♀.
?*Mutilla boopis* Zavattari, 1910, *Ann. Mus. zool. Univ. Napoli*, (3) **9** : 8, ♀.

Holotype.—♀, Celebes, in the Naturhistorisches Staatsmuseum, Vienna.

Distribution.—Known only from the type locality.

Timulla (*Trogaspidia*) *proserpina proserpina* (Smith).

Mutilla proserpina Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 85, ♀.
Mutilla proserpina Dalle Torre, 1897, *Cat. Hymen.*, **8** : 74, ♀.
——— *proserpina* André, 1903, *Gen. Insect.*, **11** : 71, ♀.
Timulla (*Trogaspidia*) *proserpina proserpina* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 175, ♀.

Holotype.—♀, Borneo : Sarawak, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—10 ♀♀, Borneo : Sandakan (*Baker*). Four of these specimens were compared with the holotype.

Distribution.—Borneo and Philippine Islands : islands of Panay, Siargao, Mindanao and Basilan.

It is doubtful if the specimens recorded from Java by Zavattari (1913) were correctly identified.

Timulla (*Trogaspidia*) *proserpina tibiata* Mickel.

Timulla (*Trogaspidia*) *proserpina tibiata* Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 176, ♀.

Holotype.—♀, Philippine Islands : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : islands of Luzon, Samar and Mindanao.

Timulla (*Trogaspidia*) *proserpina sibuyanensis* Mickel.

Timulla (*Trogaspidia*) *proserpina sibuyanensis*, Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 177, ♀.

Holotype.—♀, Philippine Islands : Sibuyan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

SPECIES UNKNOWN TO ME.

Timulla (*Trogaspidia*) *javanica* (Dalle Torre).

Mutilla fuscipennis Lepeletier, 1845, *Hist. nat. Ins., Hymen.*, **3** : 602, ♂.
Mutilla javanica Dalle Torre, 1897, *Cat. Hymen.*, **8** : 49, ♂.

Type.—♂, JAVA. Location unknown.

I was unable to find the type of this species in the Spinola collection at the University of Torino. According to the description this species belongs in the section of the genus with the scutellum gibbose or pyrimidal and the hypopygium with lateral ridges.

Timulla (*Trogaspidia*) *formosana* (Matsumura).

Mutilla formosana Matsumura, 1911, *1000 Ins. Japan, Suppl.*, **3** : 140, pl. 41, fig. 14, no. 729, ♀.
Mutilla formosana Matsumura, 1930, *Illust. 1000 Ins. Japan, Hymenopt.*, **2** : 6 (English text) : 38 (Japanese text), pl. 41, fig. 14, ♂ and ♀.
Mutilla formosana Matsumura, 1931, *6000 Illust. Ins. Japan Empire* : 29, ♂ and ♀.

I regret that the publication in which this species was described was unknown to me at the time my paper " The Mutillidae of Formosa " was published (1933). It has not been possible to examine authentic specimens of this species and it is still impossible to determine which of two Formosan female Mutillids should bear the name "*formosana*." It is probable that either *repraesentans taihorina* Mickel or *repraesentoides* Mickel is the same as *formosana* Matsumura. The male may be the same as *denotata* Mickel. It should be considered as a distinct species until reliable evidence is available regarding the sexual affinities.

SPECIES INCORRECTLY RECORDED FROM THE PACIFIC ISLANDS.

Timulla (*Trogaspidia*) *subintrans* (Sichel & Radoskowski).

Mutilla subintrans Sichel & Radoskowski, 1869, *Horae Soc. ent. ross.*, **6** : 228. ♀.

Type.—♀, CEYLON. Location unknown.

The first type locality of this species cited by the authors is Ceylon and the description was apparently made from the Ceylon specimen. The Timor specimen is in the Zoologisches Museum der Universität, Berlin. It does not have a complete pale pubescent band on the fourth tergite as mentioned in the description, but has only a pair of lateral spots of thin, golden pubescence. The name *subintrans* should be limited to the Ceylon form. I have not been able to learn where the Ceylon specimen is located, or if it is still in existence.

Timulla (*Trogaspidia*) *maculofasciata* (Saussure).

Mutilla maculofasciata Saussure, 1867, *Reise der Novara*, (*Zool.*), **2** : 107, ♀.

Holotype.—♀, CEYLON, in Naturhistorisches Staatsmuseum, Vienna.

The name *maculofasciata* should be limited to the Ceylon form. The specimens mentioned by Saussure from Timor and Luzon were certainly not conspecific. The Luzon specimen cannot be located.

Timulla (*Trogaspidia*) *gribodoi* (Magretti).

Mutilla gribodoi Magretti, 1892, *Ann. Mus. civ. Stor. nat. Genova*, (2) **12** : 229, ♂.

Type.—♂, BIRMANIA, in Museo Civico di Storia naturale, Genoa.

I have examined specimens in the Genoa Museum from Sumatra and New

Guinea determined by Mantero (1900) as this species and find after a comparison with the type that they are not conspecific with the latter. *T. gribodoi* Magretti belongs to that section of the genus with the scutellum evenly convex, not gibbose, and with the hypopygium simple.

Timulla (*Trogaspidia*) *cooki* (André).

Mutilla cooki André, 1895, *Mém. Soc. zool. Fr.*, **8** : 483, ♂ and ♀.

Type.—♀, AUSTRALIA: Queensland, in Muséum Nationale d'Histoire Naturelle, Paris.

The ♂ recorded from NEW GUINEA by Mantero (1900) is certainly not the same as the Australian species.

Smicromyrme Thomson.

Key to the Species.

♂♂.

1. Thorax, except pleural areas and usually the propodeum, ferruginous; abdomen steel-blue or black . . . . 2.
   Thorax entirely black or metallic blue, abdomen black and ferruginous, entirely black, or entirely metallic blue . . . . 19.
2. Abdominal tergites 1–3, each with a distinct, apical fringe of pale pubescence, but without appressed, pubescent bands . . . . 3.
   At least tergites 2 and 3 with an apical band of dense, appressed pubescence 7.
3. First segment of flagellum equal to one-third the length of the second; scutellum black . . . . *serpa* (Zavattari).
   First segment of flagellum equal to one-half the length of the second; scutellum ferruginous . . . . 4.
4. Thorax entirely ferruginous, except the ventral half of mesopleurae blackish *strandi* (Zavattari).
   At least the propodeum entirely black . . . . 5.
5. Abdomen dark metallic blue; pronotum entirely ferruginous *naja* (Zavattari).
   Abdomen entirely black; pronotum maculated medially with black . . 6.
6. Median area of postscutellum black; pronotum with a median, dorsal black spot . . . . *lewisi lewisi* nom. n.
   Postscutellum entirely ferruginous; pronotum black only on the median anterior face . . . . *lewisi yanoi* nom. n.
7. Abdominal tergites 1, 2 and 3 with apical bands of dense, pale pubescence 8.
   At least the first tergite without a pale, apical pubescent band . . . . 12.
8. Tegulae about one and one-half times as long as broad, roundly truncate at the apex; pale pubescent band at apical margin of second tergite narrow . . . . *electra* sp. n.
   Tegulae long, narrow, twice as long as broad, narrowly rounded at apex; pale pubescent band at apical margin of second tergite broad . . . 9.
9. Dorsal two-thirds of mesopleurae, most of metapleurae, dorsal half of sides of propodeum, dorsum of propodeum, and anterior tibiae, ferruginous; wings fuliginous . . . . 10.
   Only dorsal third of mesopleurae ferruginous; propodeum entirely and legs entirely, black; wings subhyaline. . . . . *drola* (Zavattari).
10. First two abdominal segments dark metallic blue, remainder of abdomen black . . . . *zavattarii* nom. n.
    Abdomen entirely black . . . . 11.
11. Scape black. . . . . *dardanus dardanus* (Smith).
    Scape entirely pale ferruginous . . . . . . *dardanus salacia* subsp. n.

12. Thorax entirely ferruginous . . . . 13.
 Thorax more or less marked with black . . . . 14.
13. Scape ferruginous; wings fuscous . . . . *gracillima* (Smith).
 Scape black; wings subhyaline . . . . *herophile* sp. n.
14. Propodeum entirely black . . . . 15.
 At least the dorsum of propodeum ferruginous . . . . 16.
15. Third tergite with a broad band of dense, appressed, pale pubescence *runcina* (Zavattari).
 Third tergite with only sparse, erect, pale pubescence at the apical margin *scitula* sp. n.
16. Propodeum, including the sides, entirely ferruginous, only the pleural areas black . . . . *minahassae* (Zavattari).
 Posterior face and sides of propodeum black, only the dorsum of propodeum ferruginous . . . . 17.
17. Third tergite with only a thick apical fringe of appressed, pale pubescence; disk of second tergite with sparse, moderate punctures . . . . . . 18.
 Third tergite clothed throughout with dense, appressed, pale pubescence; disk of second tergite with large, close punctures . . . . *volupia* sp. n.
18. Pronotum with large, dense, confluent punctures; apical margin of first tergite with sparse, small punctures . . . . . . *ilerda ilerda* (Cameron).
 Pronotum with large, close, distinct punctures, the latter scarcely at all confluent; apical margin of first tergite with intermixed moderate and small, distinct punctures . . . . *ilerda sparsilis* Mickel.
19. Body unicolorous, distinct metallic blue . . . . 20.
 Body bicolorous, or unicolorous, but if the latter, then entirely black . . 21.
20. Wings subhyaline; all the abdominal segments clothed with sparse, pale pubescence . . . . *caerulea* Mickel.
 Wings fuscous; second tergite with a pair of anterior, confluent spots, and a broad, apical band of tawny reddish pubescence; third, fourth and fifth tergites clothed with similar pubescence . . . *jacobsoni* (André).
21. Wings hyaline; dorsum of propodeum clothed with dense, pale pubescence, apparently without an enclosed area . . . . *devia* (Cameron).
 Wings subhyaline to fuscous; dorsum of propodeum sparsely pubescent, with a distinct, elongate, enclosed area . . . . 22.
22. Mandibles with the ventral margin straight, not at all excised, and without a tooth or process beneath at the base . . . . 23.
 Mandibles distinctly or deeply excised beneath, and with a large, prominent, broad process, or a distinct tooth at the base beneath . . . . 25.
23. Wings subhyaline; first segment of flagellum more than one-half as long as the second; pronotum densely, confluently punctate *annexa* (Cameron).
 Wings subfuscous; first segment of flagellum one-third the length of the second; pronotum with moderate, close punctures . . . . 24.
24. Abdomen with the second segment entirely, and the third segment in part or entirely, ferruginous . . . . *viriata viriata* Mickel.
 Body unicolorous, black with obscure metallic blue reflections *viriata nitela* Mickel.
25. Mandibles with a large, prominent, broad process at the base beneath; clypeus distinctly depressed below the dorsal margin of the mandibles 26.
 Mandibles without a large, prominent, broad process beneath, at the most with a distinct tooth proximad of the excision; clypeus not depressed below the dorsal margin of the mandibles . . . . 28.
26. Mandibles very broad at the apex, tridentate . . . . . *fluctuata* (Smith).
 Mandibles narrow at the apex, bidentate . . . . 27.
27. Mandibles with a high carina on the proximal half of the dorsal surface, the small tooth within subapical; clypeus without a median, longitudinal, sharp ridge . . . . *palawanensis* Mickel.

Mandibles without a high carina on the proximal half of the dorsal surface, the inner tooth remote from the apex; clypeus with a median, longitudinal, sharp ridge . . . . *zebina* (Smith).
28. Inner margin of hind coxae armed its full length with a sharp carina, posteriorly the carina lamellate and the coxae squarely truncate, thus the posterior-inner angle of hind coxae prominently angulate . . . 29.
Posterior coxae not armed with a carina posteriorly, the posterior margin of coxae not truncate, thus the posterior-inner angle of hind coxae rounded 32.
29. Scutellum with thick, appressed, pale pubescence . . *hageni* (Zavattari).
Scutellum with only sparse, erect, pubescence . . . . 30.
30. Wings subfuscous; second abdominal tergite with moderately large, distinct, separated punctures . . . . 31.
Wings subhyaline, second abdominal tergite with moderate, sparse punctures . . . . *bakeri* Mickel.
31. First two abdominal segments ferruginous . . . *semperi semperi* (Ashmead).
Abdomen entirely black . . . . *semperi melanogastra* Mickel.
32. Disk of second abdominal tergite with small, sparse punctures . . . . 33.
Disk of second abdominal tergite with moderate, close or well-separated punctures . . . . 37.
33. Pronotum with moderate, dense, confluent punctures . . . . . . 34.
Pronotum with moderate, distinct punctures . . . . 36.
34. Anterior margin of clypeus distinctly emarginate medially *caecina* (Cameron).
Anterior margin of clypeus straight, not at all emarginate . . . . . 35.
35. Second sternite with a median, longitudinal ridge on the anterior half; second flagellar segment two and one-half times as long as broad *meator* sp. n.
Second sternite without a median, longitudinal ridge; second flagellar segment only twice as long as broad . . . . *punctinota* sp. n.
36. First two or first three abdominal segments more or less ferruginous *lavinia lavinia* Mickel.
Body unicolorous, entirely black . . . . *lavinia atrata* Mickel.
37. First two or first three abdominal segments, ferruginous . . . . . 39.
Body unicolorous, black throughout . . . . 38.
38. Median area of clypeus with a pair of anterior, submarginal, distinct tubercles . . . . *lewisi nigricula* subsp. n.
Median area of clypeus not at all tuberculate . . . . *guntheri* (Zavattari).
39. Tegulae almost entirely rufo-testaceous; first three abdominal segments ferruginous . . . . *norna* (Zavattari).
Tegulae almost entirely, or entirely, blackish; only the first two abdominal segments ferruginous . . . . *drupa* (Zavattari).

♀♀

1. Second tergite with an apical band of pale pubescence, and usually with a single, anterior, median spot of pale pubescence . . . . 2.
Second tergite with three spots of pale pubescence . . . . 17.
2. Abdomen dark metallic blue . . . . 3.
Abdomen black . . . . 7.
3. Scutellar scale entirely absent . . . . 4.
Scutellar scale present; second tergite without an anterior, median spot of pale pubescence, with only an apical, pale pubescent band . *thalia* Mickel.
4. Second tergite with an anterior, median spot of pale pubescence as well as an apical, pale pubescent band . . . . 5.
Second tergite without an anterior, median, pale pubescent spot, with only a narrow, apical pale pubescent band; third tergite clothed entirely with pale pubescence; scape, coxae, trochanters, femora, and front tibiae, all ferruginous . . . . *delia* sp. n.

5. Third abdominal tergite clothed with dense, appressed pale pubescence; scape and flagellum black; intermediate femora at the apices, and apical half of posterior femora black . . . . *calliope* (Smith).
Third abdominal tergite clothed with sparse, black pubescence, that on the anterior portion pale in certain lights . . . . 6.
6. Lateral margins of dorsum of thorax parallel, the mesonotal area not narrower than the pronotal or propodeal areas; second tergite with a median, distinct, elongate, anterior spot of pale pubescence; scape pale ferruginous . . . . *hyale* Mickel.
Mesonotal area slightly but noticeably narrower than the pronotal or propodeal areas; second tergite with a median, small, obscure, anterior, pale pubescent spot; scape dark ferruginous . . . . *neaera* sp. n.
7. Third tergite entirely pale pubescent . . . . 9.
Third tergite with only a large, median, transverse spot of pale pubescence 8.
8. Scape, coxae, trochanters and femora except the tips, ferruginous, the femoral tips, tibiae and tarsi, blackish . . . . *fura fura* Mickel.
Scape and legs entirely black . . . . *fura anthracipes* Mickel.
9. Pygidial area defined laterally by a carina, distinctly, longitudinally striate 10.
Pygidial area not at all defined laterally, glabrous, impunctate
decora (Smith).
10. Thorax entirely ferruginous . . . . 12.
Thorax largely ferruginous, the pronotum medially with a more or less well-developed black spot . . . . 11.
11. Propodeum dorsally with a well-defined black spot . . *lewisi lewisi* nom. n.
Propodeum entirely ferruginous . . . . *lewisi yanoi* nom. n.
12. Scutellar scale absent; scape, coxae, trochanters and femora except tips, ferruginous . . . . *parva* (Brown).
Scutellar scale present . . . . 13.
13. Fourth tergite largely black pubescent; second tergite with small, dense, confluent punctures throughout . . . . 14.
Fourth tergite clothed with pale pubescence, except the apical fringe medially, black; second tergite with small, distinct, separated punctures throughout . . . . *thia* Mickel.
14. Anterior median, pale pubescent spot of second tergite large, subcircular, pale golden in colour . . . . 15.
Anterior, median, pale pubescent spot of second tergite small, elongate ovate, whitish in colour . . . . 16.
15. Distal margin of second tergite with a narrow band of pale pubescence, not widened medially . . . . *wotani* (Zavattari).
Distal margin of second tergite with a band of pale pubescence, very broad medially and much narrowed laterally . . . . . *kedahensis* nom. n.
16. Scape, legs and first abdominal segment ferruginous . *basalis basalis* (Smith).
Scape and legs black; first abdominal segment largely black
basalis annularis Mickel.
17. Scape and legs pale ferruginous . . . . *deidamia* (Smith).
Scape and legs piceous to black . . . . 18.
18. Apical margin of second tergite entirely black pubescent . . . . . 21.
Apical margin of second tergite with a narrow, apical band of pale golden pubescence, broadest medially . . . . 19.
19. Pale spots of second tergite transversely aligned, the median spot larger than the lateral ones; first abdominal segment black . . . . 20.
Pale spots of second tergite not transversely aligned, the median one anterior and subequal in size to the lateral ones; first abdominal segment ferruginous . . . . *triguttata* Mickel.
20. Front with moderate, close, more or less confluent punctures; lateral spots small, inconspicuous, rather obscure . . . . *autonoe* Mickel.

Front with moderate, distinct, separated punctures; lateral spots about half the size of the median spot, very distinct . . *alberici* (Zavattari).

21. Second tergite evenly convex throughout; pygidial area coarsely, longitudinally striate, the striae extending to the apical margin *zebina* (Smith).

Second tergite distinctly broadly depressed along the median, longitudinal line; pygidial area finely, longitudinally striate, the striae diverging, not extending to the apical margin . . . . . *semperi semperi* (Ashmead).

Smicromyrme strandi (Zavattari).

Mutilla strandi Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 36, ♂.
Smicromyrme strandi Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 416, ♂.

Lectotype.—♂, FORMOSA : Taihorin, October, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Smicromyrme serpa (Zavattari).

Mutilla serpa Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 39, ♂.
Smicromyrme serpa Mickel, 1933, *Ann. ent. Soc. Amer.* **26** : 417, ♂.

Lectotype.—♂, FORMOSA : Taihorinsho, August, 1909 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Smicromyrme naja (Zavattari).

Mutilla naja Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 38, ♂.
Smicromyrme naja Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, FORMOSA : Taihorin, August 7, 1911 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

Smicromyrme gracillima (Smith).

Mutilla gracillima Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 84, ♂.
Mutilla gracillima Dalle Torre, 1897, *Cat. Hymen.*, **8** : 44, ♂.
——— *gracillima* André, 1903, *Gen. Insect.*, **11** : 70, ♂.

Holotype.—♂, BORNEO : Sarawak, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the unique type.

Smicromyrme herophile sp. n.

♂. Head and abdomen entirely black; thorax entirely ferruginous; legs black, except anterior tibiae, ferruginous; abdomen with bands of dense, appressed, pale pubescence only at the posterior margin of tergites two and three; mandibles excised beneath; median, triangular area of clypeus slightly elevated, the anterior margin straight; wings subhyaline. Length, 13 mm. *Head* entirely black, clothed with pale pubescence, thick and appressed on the clypeus, thick and suberect on the front, very sparse and erect on the vertex, sparse, erect and appressed on the genae; mandibles moderately robust, bidentate at the apex, deeply excised beneath, forming a prominent blunt tooth near the base beneath; clypeus as described above; scape distinctly bicarinate beneath; first segment of flagellum equal to four-ninths the length of the second; antennal scrobes carinate above; front and vertex distinctly, longitudinally striato-punctate, the front also with a median furrow extending anteriorly from the median ocellus; genae with moderate, dense, shallow, confluent punctures; relative widths of head and thorax at the tegulae, 4·4–5·0. *Thorax* entirely ferruginous, without black on the pleurae or sternum, the pronotum, mesonotum and scutellum clothed with sparse, erect, ferruginous pubescence, the remainder with sparse, pale pubescence, erect and appressed, and most evident on the propodeum and mesopleurae; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures, densest on the scutellum; humeral angles subangulate; parapsidal furrows distinct on posterior two-thirds of mesonotum; dorsum, posterior face and sides of propodeum rounded into one another, distinctly reticulate, the sides more shallowly so than the remainder; enclosed area of dorsum of propodeum short, one and one-fourth times as long as the width anteriorly, the anterior third much broader than the posterior two-thirds; propleurae defined anteriorly by a carina, micropunctate and with scattered, shallow, obscure, moderate punctures; mesopleurae with moderate, dense, shallow, confluent punctures throughout, except the anterior marginal area micropunctate; metapleurae micropunctate, except ventrally with shallow, moderately large punctures; tegulae ferruginous, translucent, one and two-thirds times longer than broad, glabrous, with scattered, small, indistinct punctures, and very sparse, ferruginous pubescence. *Abdomen* entirely black, the first two segments with very faint and obscure, dark metallic blue reflections; first four segments clothed with sparse, pale pubescence, the remainder with sparse, black pubescence, the first tergite also with a thin, apical fringe of pale pubescence, the second tergite with a narrow, apical band of dense, appressed, pale pubescence, and the third with a broad band of dense, appressed, pale pubescence; first tergite with sparse, moderately large punctures, becoming very small and close at the posterior margin, moderate and very close at the lateral margins; second tergite with moderate, sparse punctures on the disk, becoming smaller at the posterior margin, somewhat closer laterally; tergites four to six with small, distinct punctures; last tergite with small, close, distinct punctures, except a median, elongate, triangular area on the posterior half glabrous, impunctate; first sternite with a prominent, median, longitudinal carina on the anterior two-thirds; second sternite with sparse, moderately large punctures, becoming somewhat closer laterally and posteriorly; sternites four to six, and hypopygium with small, distinct punctures. *Wings* subhyaline throughout; distance between origin of vein M and the base of the stigma almost equal to twice the length of the latter; cell 2nd $R_1 + R_2$ not truncate at the apex; cell R_5 receiving vein M_{3+4} slightly before the middle in one wing, and slightly posterior to the middle in the other; cell R_4 present but less distinct than R_5 and receiving vein M_2 at about two-thirds the distance from base to apex. *Legs* black, except the anterior tibiae ferruginous, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♂, JAVA: Pekalongan (*F. Muir*), in University of Minnesota collection.

Related to *gracillima* Smith, but differs in having the scape and antennal tubercles entirely black, in the pale wings which are entirely subhyaline, and in having only the anterior tibiae ferruginous. The holotype was reared from a host cocoon with which it is pinned, but which has not been identified.

Smicromyrme minahassae (Zavattari).

Mutilla minahassae Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 95, ♂.

Type.—♂, CELEBES: Minahassa, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

The original material consists of two males collected at the same time and place. A lectotype has not been designated.

Smicromyrme volupia sp. n.

♂. Head and legs, black; thorax, ferruginous, except ventral half of pleural areas, sides of propodeum and posterior face of propodeum, all black; abdomen, very dark metallic blue; first abdominal tergite with only a thin, apical fringe of pale pubescence; posterior margin of second tergite with a band, and third tergite clothed entirely, with dense, appressed, pale pubescence; mandibles slightly emarginate beneath but without a tooth near the base; last tergite with a posterior, median, triangular, impunctate area. Length, 15 mm. *Head* black, except the mandibles subterminally, the antennal tubercles, and the first two segments of the flagellum beneath, ferruginous; front and vertex clothed with ferruginous pubescence, much sparser on the vertex than on the front; remainder of head clothed with sparse, pale pubescence, that on the clypeus appressed; mandibles moderately robust, distinctly bidentate terminally, slightly emarginate beneath but without a tooth beneath near the base; clypeus transverse, the posterior half with an obscure, median, longitudinal carina, the anterior margin medially, broadly and shallowly concave; scape distinctly bicarinate beneath, dorsally with dense, small punctures; first segment of flagellum about one-fifth the length of the second, viewed from beneath; antennal scrobes carinate above; front and vertex distinctly, longitudinally striatopunctate, the front with a distinct furrow extending anteriorly from the anterior ocellus to the antennal tubercles; genae with moderate, close, shallow, confluent punctures; relative widths of head and thorax at the tegulae, 4·7–5·4. *Thorax* ferruginous, except the ventral half of pleural areas, sides and posterior face of propodeum, black; pronotum, mesonotum and scutellum with moderately large, dense, confluent punctures, and clothed with sparse, erect, ferruginous pubescence; parapsidal furrows present on mesonotum posteriorly but weakly developed; dorsum and posterior face of propodeum reticulate, the reticulations on the dorsum large and deep, becoming small and shallow on the posterior face, both clothed with sparse, long, erect, pale pubescence; propleurae defined anteriorly by a distinct, sharp carina; propleurae micropunctate with shallow, moderate punctures at the dorsal and posterior margins; mesopleurae with moderately large, dense, confluent punctures, except the anterior margin micropunctate, clothed with sparse, erect and subappressed, pale pubescence; metapleurae micropunctate and micropubescent, except ventrally with moderate, shallow punctures; sides of propodeum reticulate, the meshes small and shallow, the sides rounded into the posterior face and the dorsum; tegulae ferruginous, large, about twice as long as broad, with sparse, small punctures, and sparse, erect, ferruginous pubescence. *Abdomen* very dark metallic blue, the first three segments clothed with sparse, erect, pale pubescence, the first tergite with a thin, apical fringe of pale pubescence, the second with a band of dense, appressed, pale pubescence at the posterior margin, and the third clothed entirely with dense, appressed, pale pubescence; remaining abdominal segments clothed with sparse, erect, black pubescence; first tergite with large, deep, close punctures except the posterior and lateral fourths with moderate, close punctures; second tergite with moderate punctures, distinct and separated on the disk, close and confluent laterally, becoming smaller at the posterior margin; pubescence of third tergite obscuring the puncturation; tergites four to six with small, distinct punctures, closer laterally than medially; last tergite with moderate, close punctures, except a median, triangular area on the posterior two-thirds glabrous and impunctate; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina higher posteriorly; second sternite with moderately large, distinct punctures, somewhat closer laterally than medially; sternites three to six with small, distinct punctures; hypopygium margined laterally, with moderately small, shallow punctures. *Wings* fuliginous; distance between the origin of vein M and the stigma slightly more than twice the length of the latter; cell 2nd $R_1 + R_2$ squarely truncate at the apex; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but less distinct than R_5 and receiving vein M_2 about five-eighths the distance from base to apex. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Bettotan, near Sandakan, August 22, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratype.—♂, Borneo: Bettotan, near Sandakan, August 7, 1927 (*C. B. K.* and *H. M. P.*).

The mandibles without a tooth beneath, second and third tergites only with dense, pale pubescent bands, and the glabrous, impunctate, triangular area of last tergite characterise this species.

Smicromyrme ilerda ilerda (Cameron).

Mutilla ilerda Cameron, 1902, *J. Straits Br. R. Asiatic Soc.*, **37** : 78, ♂.

Holotype.—♂, Borneo: Kuching, Sarawak, in British Museum (Natural History).

Specimens examined.—3 ♂♂, N.W. Borneo: Kuching, July 17, September 6 and 15, 1900 (*Dyak*); ♂, Borneo: Sandakan (*Baker*).

Distribution.—Known only from Borneo.

Smicromyrme ilerda sparsilis Mickel.

Smicromyrme ilerda sparsilis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 191, ♂.

Holotype.—♂, Philippine Islands: Dapitan, Mindanao, in United States National Museum.

Distribution.—Philippine Islands: Mindanao.

Smicromyrme hyale Mickel.

Smicromyrme hyale Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 193, ♀.

Holotype.—♀, Philippine Islands: Iligan, Mindanao, in United States National Museum.

Distribution.—Philippine Islands: Mindanao.

This may be the female of *ilerda sparsilis*.

Smicromyrme neaera sp. n.

♀. Head black, except the mandibles, antennal tubercles, scape and flagellum beneath, ferruginous; thorax entirely ferruginous; abdomen dark metallic blue; legs ferruginous, except the tibiae and tarsi blackish; gular margin elevated into a small, distinct tooth posterior to the insertion of the mandibles; mesonotal area of thorax slightly but noticeably narrower than the pronotal or propodeal areas, thus the lateral margins of dorsum of thorax not straight and parallel but narrowed medially; scutellar scale absent; second tergite with a small, median, obscure spot of pale, appressed pubescence at the anterior margin; tergite three without a band of appressed, pale pubescence; pygidial area distinctly margined laterally, glabrous, unsculptured, except anteriorly very weakly, obscurely, longitudinally rugose. Length, 7 mm. *Head* black, except the mandibles and antennal tubercles bright ferruginous, the scape dark ferruginous and the flagellum tinged with ferruginous beneath; mandibles dark and edentate at the tip, with a small, distinct tooth within near the apex; clypeus moderately elevated posteriorly into a transverse, arcuate ridge; first segment of flagellum slightly longer than the third; antennal scrobes carinate above; front, vertex and genae with moderate, close, only slightly confluent punctures, the front and vertex clothed with sparse, fuscous pubescence, the genae with sparse, pale pubescence; relative widths of head and thorax, 2·9–2·3. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect and suberect, ferruginous pubescence, the posterior face of propodeum with sparse, pale pubescence and the pleural areas with pale micropubescence; humeral angles subangulate, not prominent; lateral margins of dorsum of propodeum crenulate, the mesonotal area slightly but noticeably narrower than the pronotal or propodeal areas; scutellar scale absent; dorsum with moderately large, dense, deep, confluent punctures, becoming reticulate near the posterior margin; posterior face of propodeum reticulate anteriorly, the remainder with small, sparse punctures; lateral margins of posterior face of propodeum not dentate nor denticulate; propleurae defined anteriorly by a distinct carina; all pleural areas micropunctate. *Abdomen* dark metallic blue except the first sternite ferruginous, clothed with sparse, pale pubescence, except the disk of the second tergite with sparse, erect and appressed, black pubescence, and the median three-fourths of tergites four and five with sparse, erect, blackish pubescence; third tergite with sparse pubescence, pale laterally, dark medially except the latter pale in certain lights, but without a band of dense, appressed pale pubescence; last tergite with thick, erect, pale pubescence laterally; all the sternites with thin, apical fringes of pale pubescence; first tergite with sparse, moderately small punctures, with intermixed micropunctures laterally; disk of second tergite with small, dense punctures, the latter becoming well separated on the lateral areas of the tergite; second tergite with a small, median, obscure spot at the anterior margin, and a broad band at the posterior margin of dense, appressed, pale pubescence; tergites three to five with fine, distinct punctures; last tergite with a distinct pygidial area, margined laterally, the sides parallel, about twice as long as broad, the anterior half weakly, obscurely, longitudinally rugose, the posterior half glabrous, unsculptured; first sternite with a high, distinct carina on the anterior two-thirds; second sternite with moderate, distinct punctures; sternites three to five with small, close punctures posteriorly; hypopygium with a median, transverse area of small, dense punctures. Coxae, trochanters and femora, ferruginous, the tibiae and tarsi, blackish; *legs* clothed with sparse, pale pubescence throughout; calcaria pale.

Holotype.—♀, Borneo: Sandakan (*Baker*), Cat. no. 50045 United States National Museum.

Related to *hyale* Mickel, but differs in the narrowed, median portion of thorax, and the obscure, median anterior spot on second abdominal tergite.

Smicromyrme runcina (Zavattari).

Mutilla runcina Zavattari, 1913, *Boll. Soc. ent. ital.*, **45**: 94, ♂.

Holotype.—♂, Borneo: Bandjermasin, in Museo Civico di Storia naturale, Genoa.

Specimens examined.—3 ♂♂, Borneo: Sandakan (*Baker*); ♂, Borneo: Bettotan, near Sandakan, August 10, 1927 (*C. B. K.* and *H. M. P.*).

Distribution.—Borneo.

Smicromyrme scitula sp. n.

♂. Head and legs black; thorax ferruginous, except the ventral half of the mesopleural and metapleural areas, and the propodeum, entirely black; abdomen dark metallic blue, with an apical band of dense, appressed, pale pubescence only on the apical margin of the second tergite; wings subfuscous. Length, 10 mm. *Head* black, except the antennal tubercles ferruginous, and the first segment of the flagellum beneath tinged with ferruginous, clothed with sparse, erect and appressed, pale pubescence, except the clypeus with thick, appressed, pale pubescence; mandibles moderately robust, bidentate at the apex, emarginate beneath forming a short, blunt tooth beneath near the base; clypeus transverse, micropunctate, with a median, obscure, longitudinal carina on the posterior half, the carina becoming sharp and prominent at the posterior margin; scape distinctly bicarinate beneath; first segment of flagellum about one-third the length of the second when viewed from beneath; antennal scrobes carinate above; front and vertex distinctly, longitudinally striato-punctate, the front with a prominent median furrow extending anteriorly from the anterior ocellus; posterior margin of vertex arcuate; genae with moderate, close punctures; relative widths of head and thorax at the tegulae, 3·2–3·7. *Thorax* ferruginous, except the ventral half of the mesopleurae and metapleurae, and the propodeum entirely, black; pronotum, mesonotum and scutellum with sparse, erect, ferruginous pubescence and moderately large, dense, more or less confluent punctures, the mesonotum with the punctures less dense than the pronotum or scutellum; parapsidal furrows of mesonotum present posteriorly but obscure; humeral angles subangulate, not prominent; dorsum and posterior face of propodeum reticulate, clothed with sparse, erect, pale pubescence, rounded into one another and into the sides of propodeum; dorsum with a median enclosed area about twice as long as broad, the sides sinuate; propleurae defined anteriorly by a distinct carina, micropunctate and with obscure, moderate punctures at the dorsal and posterior margins; mesopleurae with moderate, close, more or less confluent punctures except the anterior marginal area micropunctate, the whole clothed with sparse, erect and appressed, pale pubescence; metapleurae micropunctate and micropubescent except ventrally with moderate, close punctures; sides of propodeum shallowly reticulate, clothed with sparse, pale pubescence; tegulae ferruginous, with small, sparse, indistinct punctures, clothed with sparse, ferruginous pubescence. *Abdomen* entirely dark metallic blue, the first three segments clothed with sparse, erect, pale pubescence, and the second tergite also with a band of dense, appressed, pale pubescence at the posterior margin, the remaining segments with sparse, erect, black pubescence; first tergite with sparse, moderate punctures, the latter becoming smaller and closer at the lateral margins; second tergite with small, sparse punctures, becoming somewhat larger and closer at the lateral margins, but smaller and closer at the posterior margin; remaining tergites with moderately small, well-separated punctures, the last tergite without a distinct, glabrous, impunctate area; first sternite with a distinct carina on the anterior three-fourths; second sternite with moderate, distinct, well-separated punctures throughout; sternites three to six with small, distinct punctures posteriorly; hypopygium with moderately small, distinct, close punctures. *Wings* light fuscous; distance between the origin of vein M and the stigma about one and one-fourth times the length of the stigma; cell 2nd $R_1 + R_2$ rounded apically; cell R_5 receiving vein M_{3+4} at about the middle; cell R_4 present but less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50046 United States National Museum.

Paratypes.—3 ♂♂, Borneo: Sandakan (*Baker*); ♂, Borneo: Bettotan, near Sandakan, August 22, 1927 (*C. B. K.* and *H. M. P.*).

Differs from *runcina* in lacking the pale pubescent band on the third tergite; differs from *ilerda ilerda* in having the propodeum entirely black.

Smicromyrme electra sp. n.

Mutilla unimaculata Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5**: 75, ♂ (*nec* ♀) (*nec* 1858).

♂. Head, abdomen and legs, black; thorax, ferruginous, except the sternum, black; first and second abdominal tergites each with a narrow, apical band of pale pubescence, the third tergite with a broad, apical band of dense, appressed, pale pubescence; mandibles excised beneath, forming a distinct blunt tooth beneath near the base; wings subfuscous.

Length, 15 mm. *Head* black, except the antennal tubercles ferruginous, clothed with pale pubescence, thick and appressed on clypeus, thick and suberect on front, very sparse, almost wanting on vertex, and sparse on genae; mandibles somewhat robust, bidentate at the apex, strongly excised beneath forming a blunt, angulate tooth beneath near the base; clypeus transverse, finely, shallowly punctate, elevated longitudinally along the median line forming a ridge, the anterior margin medially, straight; scape bicarinate beneath; first segment of flagellum two-fifths the length of the second; antennal scrobes carinate above; front and vertex distinctly, longitudinally striato-punctate, the front with a distinct, median furrow extending anteriorly from the anterior ocellus; genae with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulae, 4·6–5·3. *Thorax* ferruginous, except the sternum, black, the pronotum, mesonotum and scutellum with sparse, erect, ferruginous pubescence, the mesopleurae and propodeum with sparse, erect, pale pubescence; pronotum, mesonotum and scutellum with moderately large, close, somewhat confluent punctures; humeral angles subangulate, not prominent; dorsum, posterior face and sides of propodeum rounded into one another, all reticulate, the sides more shallowly so than elsewhere; dorsum with an elongate, irregular, median enclosed area; anterior margin of propleurae defined by a carina; propleurae with moderately large, shallow punctures; mesopleurae with moderate, close, somewhat confluent punctures except the anterior marginal area micropunctate; metapleurae micropunctate and micropubescent except ventrally with moderate, shallow punctures; tegulae large and broad, slightly less than one and one-half times as long as broad, with sparse, indistinct, small punctures, and sparse, erect, ferruginous pubescence. *Abdomen* entirely black, the first four segments, except the posterior fourth of the fourth tergite, clothed with sparse, erect, pale pubescence, the first and second tergites also with narrow, apical bands of thick, pale pubescence, and the third with a broad band of dense, appressed, pale pubescence; posterior fourth of fourth tergite and the remaining abdominal segments with sparse, erect, black pubescence; first tergite with moderately large, sparse punctures, the latter becoming smaller and closer at the posterior and lateral margins; second tergite with moderately large, sparse punctures on the disk, the punctures becoming closer laterally, smaller and closer at the posterior margin; third tergite with intermixed small and moderate, close punctures beneath the pale pubescent band; tergites four to six with small, distinct punctures; last tergite with small, distinct punctures except a median, elongate, triangular area on the posterior half glabrous and impunctate; first sternite with a prominent, median, longitudinal carina on the anterior three-fourths; second sternite with moderate, distinct punctures throughout; sternites three to six with small, distinct punctures; hypopygium with small, distinct punctures. *Wings* subfuscous; distance between origin of vein M and the stigma about one and one-half times the length of the latter; cell 2nd $R_1 + R_2$ rounded apically; cell R_5 receiving vein M_{3+4} at three-fifths the distance from base to apex; cell R_4 present but less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, CELEBES: Macassar, in Saunders' coll., Hope Dept. Oxford University. Mounted on same pin as female paratype of *Odontomutilla smithi* Mickel.

This is the specimen recorded by Smith (1861) as the male of *Odontomutilla unimaculata*. It is not an *Odontomutilla* but unquestionably a *Smicromyrme*. How Smith came to record it as having been taken *in coitu* with the female *Odontomutilla* is unknown. See notes under *Odontomutilla smithi*.

This species may be recognised by the entirely black abdomen with pale pubescent bands on each of the first three segments, and by the broader tegulae, as well as the pale wings.

Smicromyrme dardanus dardanus (Smith).

Mutilla dardanus Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 86, ♂.
Mutilla dardanus Dalle Torre, 1897, *Cat. Hymen.*, **8** : 30, ♂.
Mutilla dardanus André, 1903, *Gen. Insect.*, **11** : 39, ♂.

Holotype.—♂, Borneo : Sarawak, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—♂, Borneo : Lunda, Sarawak, 6.i.14 (*G. E. Bryant*).

Distribution.—Known only from Borneo.

I have not examined the specimens recorded by André (1896) from Malay Peninsula : Perak, as belonging to this species. It is probable that neither are conspecific with subsp. *dardanus*.

Smicromyrme dardanus salacia subsp. n.

♂. Almost exactly like the subsp. *dardanus* but with the scape entirely pale ferruginous, and the holotype with the middle femora ferruginous and the proximal half of the middle tibiae tinged with ferruginous, in addition to the ferruginous anterior femora and tibiae ; the sculpture and form of the body, and the pale pubescent bands of the abdominal tergites are the same as in subsp. *dardanus*.

Holotype.—♂, N. Borneo : Samawang, near Sandakan, July 10, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratypes.—2 ♂♂, N. Borneo : Samawang, near Sandakan, July 15, 1927 (*C. B. K.* and *H. M. P.*).

One paratype has the middle femora dark ferruginous, and the other has the middle femora practically black; both have the pale ferruginous scape as in the holotype.

Smicromyrme zavattarii sp. n.

Mutilla gracillima Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 92, ♂ (*nec* Smith).

Holotype.—♂, Borneo : Bandjermasin (labelled "*M. gracillima*"), in Museo Civico di Storia naturale, Genoa.

I have not examined Zavattari's specimen, but it is clear from his description that the specimen he described is not *gracillima* Smith. The latter has pale pubescent bands only on abdominal tergites two and three, while *zavattarii* has pale pubescent bands on tergites one, two and three. In this respect it is like *dardanus dardanus*, but the former has the first two abdominal segments dark metallic blue. *S. zavattarii* is the only described species in this group with pale pubescent bands on the first three abdominal segments that has the abdomen in part metallic blue, the abdomen of the others being entirely black.

Smicromyrme drola (Zavattari).

Mutilla drola Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 37, ♂.
Smicromyrme drola Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, Formosa : Taihorin, November, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

Smicromyrme delia sp. n.

♀. Head black, except the mandibles, antennal tubercles and scape, ferruginous; thorax entirely ferruginous; abdomen dark metallic blue, except the anterior two-thirds of first segment, ferruginous; legs ferruginous, except the tarsi, blackish; scutellar scale entirely absent; thorax narrower posteriorly than anteriorly; second tergite without an anterior, median, pale pubescent spot, but with a narrow, apical, pale pubescent band slightly dilated medially; third tergite entirely pale pubescent; pygidial area not margined laterally, glabrous, unsculptured. Length, 6·5 mm. *Head* black, except the mandibles, antennal tubercles and scape ferruginous, the front and vertex with sparse, erect, fuscous pubescence, the genae with sparse, pale pubescence; gular margin not elevated into a tooth posterior to the insertion of the mandibles; mandibles slender, edentate at the apex and apparently with a small tooth within near the apex; clypeus elevated posteriorly into a sharp, arcuate ridge; first segment of flagellum slightly longer than the second; flagellum somewhat tinged with ferruginous beneath; antennal scrobes not noticeably carinate above; front and vertex with moderately small, distinct, separated punctures, the genae with moderately small, close, more or less confluent punctures; relative widths of head and thorax, 2·3–2·0. *Thorax* entirely ferruginous, the dorsum clothed with sparse, erect and recumbent, dark ferruginous pubescence, the posterior face of propodeum with sparse, long, erect, pale pubescence, and the pleural areas micropubescent; thorax narrower posteriorly than anteriorly, the relative widths of pronotum, mesonotum and propodeum, 2·0–1·9–1·7; lateral margins of dorsum of thorax crenulate; dorsum of thorax with moderately large, dense, confluent punctures becoming reticulate on the dorsum of propodeum; humeral angles subangulate, not prominent; scutellar scale absent; posterior face of propodeum reticulate anteriorly, obscurely sculptured posteriorly; lateral margins of posterior face of propodeum not dentate nor denticulate; propleurae defined anteriorly by a carina, with small, shallow, obscure punctures; remainder of pleural areas micropunctate. *Abdomen* dark metallic blue above, tinged with ferruginous beneath, except the anterior two-thirds of the first tergite and the first sternite entirely, ferruginous; first tergite, second tergite at lateral and posterior margins, last tergite laterally, and all the sternites with sparse, erect, pale pubescence; disk of second tergite, and fourth and fifth tergites with sparse, erect (and the second tergite also with sparse, appressed), black pubescence; second tergite with a narrow, band of dense, appressed, pale pubescence at the posterior margin, slightly dilated medially; third tergite clothed entirely with dense, appressed, pale pubescence; first tergite with sparse, small punctures; second tergite with very small, distinct, close punctures becoming more separated laterally; puncturation of third tergite not visible; fourth and fifth tergites with fine, shallow punctures; pygidial area present but not margined laterally, glabrous, unsculptured; first sternite with a median, longitudinal carina on the anterior three-fourths; second sternite with small, sparse punctures; sternites three to five with very small, close, obscure punctures posteriorly; hypopygium with small, obscure punctures. *Legs* bright ferruginous, except the tibiae somewhat infuscated, and the tarsi blackish, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—♀, N. Borneo: Bettotan, near Sandakan, August 20, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratype.—♀, N. Borneo: Bettotan, near Sandakan, August 13, 1927 (*C. B. K.* and *H. M. P.*).

Differs from related females in having the thorax narrowed posteriorly, the absence of a pale pubescent spot anteriorly on the second tergite, the third tergite entirely pale pubescent, and in the pygidial area not margined laterally.

Smicromyrme thalia Mickel.

Promecilla calliope Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 23, ♀ (*nec* Smith).
Smicromyrme thalia Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♀.

Holotype.—♀, Formosa: Taihorin, August 7, 1911 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from Formosa.

Smicromyrme calliope (Smith).

Mutilla calliope Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 85, ♀ (*nec* ♂).
Mutilla calliope, Dalle Torre, 1897, *Cat. Hymen.*, **8** : 19, ♀.
Promecilla calliope, André, 1903, *Gen. Insect.*, **11** : 31, ♀.

Holotype.—♀, Borneo : Sarawak, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—♀, Borneo : Sandakan (*Baker*).

Distribution.—Known only from Borneo.

The specimen described by Smith as the male of this species is not congeneric with the female *calliope*, but belongs to the genus *Squamulotilla*. See discussion under *Squamulotilla calliopeia.*

Smicromyrme caerulea Mickel.

Smicromyrme caerulea Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 201, ♂.

Holotype.—♂, Philippine Islands : Samar, in United States National Museum.

Distribution.—Known only from the type locality.

Smicromyrme jacobsoni (André).

Mutilla jacobsoni André, 1907, *Z. Hymen. Dipt.*, **7** : 207, ♂.
Mutilla jacobsoni André, 1909, *Notes Leyden Mus.*, **31** : 172, ♂.

Holotype.—♂, Java : Semarang, in Museum of Natural History, Leyden.

Distribution.—Known only from the type locality.

I have not examined the type of *jacobsoni*, but it is unquestionably a *Smicromyrme* and apparently related to *caerulea.* The latter and *jacobsoni* are the only described species which have the body entirely metallic blue throughout.

Smicromyrme devia (Cameron).

Mutilla devia Cameron, 1909, *Entomologist*, **42** : 147, ♂.

Holotype.—♂, Borneo : Kuching (*John Hewitt*), in British Museum (Natural History).

Distribution.—Known only from the type locality.

I have not examined the specimen recorded by Zavattari (1913) from the Island of Simueloe, but think it doubtful that the two are conspecific.

Smicromyrme annexa (Cameron).

Mutilla annexa Cameron, 1909, *Entomologist*, **42** : 146, ♂.

Holotype.—♂, Borneo : Kuching (*John Hewitt*), in British Museum (Natural History).

Specimens examined.—♂, Borneo : Sandakan (*Baker*).

Distribution.—Known only from Borneo.

Smicromyrme viriata viriata Mickel.

Smicromyrme viriata viriata Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 195, ♂.

Holotype.—♂, Philippine Islands : Iligan, Mindanao (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : islands of Luzon, Samar, Sibuyan, Panay, Biliran and Mindanao.

Smicromyrme viriata nitela Mickel.

Mutilla nigra Bingham, 1895, *Ann. Mag. nat. Hist.*, (6), **16** : 440, ♂ (*nec* Smith).
Smicromyrme viriata nitela Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 197, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Mt. Makiling, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS : islands of Luzon, Samar, Negros and Mindanao.

Smicromyrme caecina (Cameron).

Mutilla caecina Cameron, 1903, *J. Straits Br. R. Asiatic Soc.*, **39** : 153, ♂.

Holotype.—♂, BORNEO : Lingga, Sarawak, in British Museum (Natural History).

Specimens examined.—9 ♂♂, BORNEO : Sandakan (*Baker*); ♂, W. BORNEO : Mowong, September, 1907 (*F. Muir*).

Distribution.—Known only from BORNEO.

Smicromyrme meator sp. n.

♂. Entirely black, except the first three abdominal segments and the antennal tubercles ferruginous; mandibles deeply excised beneath; anterior margin of clypeus straight, not emarginate; first segment of flagellum equal to half the length of the second; pronotum densely, somewhat confluently punctate; disk of second tergite with small, sparse punctures; wings fuscous with violet reflections. Length, 14 mm. *Head* entirely black, except the antennal tubercles ferruginous, and the mandibles medially tinged with ferruginous, clothed with sparse, long, erect, and sparse, short, appressed, pale pubescence, except thick on the front and clypeus, and the vertex practically bare; mandibles edentate at the apex and with a small tooth within near the apex, deeply excised beneath forming a blunt tooth beneath near the base; clypeus transverse, almost flat, not emarginate medially, the medial anterior margin glabrous; scape bicarinate beneath; first segment of flagellum half the length of the second; second segment of flagellum two and one-half times as long as broad; antennal scrobes carinate above; front and vertex distinctly longitudinally striato-punctate, the front also with a median furrow extending anteriorly from the median ocellus; genae with moderately small, shallow punctures; relative widths of head and thorax at the tegulae, 4·2–5·0. *Thorax* entirely black, clothed throughout with sparse, long, erect, and sparse, short, appressed, pale pubescence, except the mesonotum and scutellum with only sparse, erect, pale fuscous pubescence, the pronotum with a narrow line of thick, appressed, pale pubescence on the posterior margin, and the pale pubescence thick on the mesopleurae; pronotum with moderately large, dense, somewhat confluent punctures; humeral angles subangulate; mesonotum with large, close but distinct punctures, closer laterally than medially; parapsidal furrows distinct throughout; scutellum with moderately large, dense, confluent punctures; dorsum, posterior face and sides of propodeum rounded into one another, the dorsum and posterior face reticulate, the sides more narrowly and shallowly reticulate than the dorsum and posterior face; dorsum of propodeum with a median enclosed space about twice as long as the width anteriorly, the sides converging posteriorly; propleurae with the anterior margin defined by a carina, obscurely, longitudinally striato-punctate; mesopleurae medially with moderate, shallow, close punctures, the anterior and posterior fourths micropunctate and with scattered, moderate punctures; metapleurae micropunctate except ventrally with large, shallow, scattered punctures; tegulae large, glabrous, with scattered, indistinct punctures and sparse, pale pubescence. First three *abdominal segments* ferruginous, the remainder of the abdomen, black, the first five segments clothed with sparse, erect, pale pubescence, the remaining segments with sparse, erect, blackish pubescence; first tergite with sparse, moderate punctures on the disk, becoming close laterally, small and somewhat closer posteriorly; second tergite with sparse, small punctures on the disk, the punctures becoming somewhat larger and closer at the lateral margins; tergites three to six with sparse, small punctures, except laterally the punctures closer and larger; last tergite with moderately small, close, somewhat confluent punctures, except along the median longitudinal line glabrous, impunctate; first sternite with a median longitudinal carina on the anterior three-fourths; second sternite with narrow, lateral felt lines, and with a low, median, longitudinal ridge on the anterior half, with sparse, small punctures, the latter becoming slightly larger posteriorly and laterally; sternites three to six with moderately small, distinct punctures; hypopygium with intermixed moderately large to small, distinct punctures. *Wings* fuscous with violet reflections; distance between origin of vein M and the stigma twice the length of the latter; cell 2nd $R_1 + R_2$ obliquely truncate at the apex; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but indistinct and receiving vein M_2 at two-thirds the distance from base to apex. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, Borneo: Sandakan (*Baker*), Cat. no. 50047, United States National Museum.

Paratypes.—2 ♂♂, Borneo: Sandakan (*Baker*); 6 ♂♂, Borneo: Bettotan, near Sandakan, August 2, 6, 7, 9, 10 and 14, 1927 (*C. B. K.* and *H. M. P.*).

Related to *caecina* Cameron, but has the anterior clypeal margin straight, the first segment of flagellum longer, and is larger. The paratypes range in length from 11 to 16 mm. Seven of the paratypes have the third abdominal segment black instead of ferruginous, but otherwise do not differ from the holotype.

Smicromyrme punctinota sp. n.

♂. Entirely black, except the first two abdominal segments and the antennal tubercles, ferruginous; mandibles excised beneath; anterior margin of clypeus straight, not emarginate; second flagellar segment twice as long as broad; mesonotum with dense, confluent punctures; second tergite with small, sparse punctures; wings fuscous. Length, 13 mm. *Head* black, except the antennal tubercles, ferruginous, and the mandibles medially tinged with ferruginous; clothed with pale pubescence, thick and appressed on the clypeus, thick and suberect on the front, very sparse and erect on the vertex, sparse, erect and appressed on the genae; mandibles edentate at the apex and with a distinct tooth within near the apex, deeply excised beneath forming a prominent tooth near the base beneath; clypeus slightly but noticeably transversely depressed medially, the anterior margin not emarginate; scape bicarinate but the anterior carina much stronger and more prominent than the posterior; first segment of flagellum equal in length to half the length of the second, the latter only twice as long as broad; antennal scrobes carinate above; front and vertex distinctly, longitudinally striato-punctate, the front also with a shallow, median furrow extending anteriorly from the median ocellus; genae with moderately small, shallow, dense, confluent punctures; relative widths of head and thorax at the tegulae, 4·3–5·1. *Thorax* entirely black, the mesonotum with sparse, black pubescence, the remainder with pale pubescence, that on the pronotum and propodeum sparse, erect and appressed, on the mesopleurae thick, erect and appressed; pronotum with moderately large, somewhat shallow, dense, confluent punctures; humeral angles subangulate; mesonotum with moderately large, dense, distinct, only slightly confluent punctures throughout, without a glabrous area at the anterior middle; parapsidal furrows present but obscure on the anterior third of mesonotum; scutellum with moderately dense, shallow, confluent punctures; dorsum, posterior face and sides of propodeum rounded into one another, distinctly reticulate, the sides more narrowly and shallowly reticulate than elsewhere; dorsum of propodeum with an enclosed space about three times as long as its width anteriorly, the sides sinuate; propleurae defined anteriorly by a carina, obscurely, shallowly, longitudinally striato-punctate; dorsal and ventral areas of mesopleurae separated by a transverse furrow, with moderate, shallow, confluent punctures, except the anterior and posterior areas of each micropunctate; metapleurae micropunctate except for moderately large, shallow punctures ventrally; tegulae black except the posterior third testaceous, translucent, the whole glabrous, with sparse, small, indistinct punctures and sparse, pale fuscous to black pubescence. *Abdomen* black, except the first two abdominal segments ferruginous, the first five segments with sparse, erect, pale pubescence, the remainder with sparse, erect, black pubescence; first and second tergites with sparse, small punctures, except the lateral margins with the punctures close; tergites three to six with sparse, small punctures, somewhat less sparse than on the second tergite; last tergite with moderately small, dense, more or less confluent punctures; first sternite with a median, longitudinal carina on the anterior three-fourths; second sternite with narrow, lateral, felt lines, without a median, longitudinal ridge, and with moderately small, sparse punctures; sternites three to six, and the hypopygium with moderately small, distinct punctures. *Wings* fuscous with violet reflections; distance between origin of vein M and the stigma one and one-half times the length of the latter; cell 2nd $R_1 + R_2$ obscurely, obliquely truncate at the apex; cell R_5 receiving vein M_{3+4} at two-thirds the distance from base to apex; cell R_4 indistinct, receiving vein M_2 at three-fifths the distance from base to apex. *Legs* entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—♂, N. Borneo : Bettotan, near Sandakan, August 21, 1927 (*C. B. K.* and *H. M. P.*), in British Museum (Natural History).

Paratypes.—2 ♂♂, N. Borneo : Bettotan, near Sandakan, August 4 and 16, 1927 (*C. B. K.* and *H. M. P.*).

Very close to *meator*, but differs in lacking the ridge on the second sternite, in the shorter flagellar segments (the second only twice as long as broad), in the more densely punctate mesonotum and the slightly depressed clypeus. The paratypes are each 10 mm. in length.

Smicromyrme lavinia lavinia Mickel.

Smicromyrme lavinia lavinia Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 214, ♂.

Holotype.—♂, Philippine Islands : Mt. Banahao, Luzon (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : islands of Luzon and Mindanao.

Smicromyrme lavinia atrata Mickel.

Smicromyrme lavinia atrata Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 216, ♂.

Holotype.—♂, Philippine Islands : Samar (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Smicromyrme guntheri (Zavattari).

Mutilla guntheri Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 33, ♂.
Smicromyrme guntheri Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, Formosa : Taihorinsho, October, 1909 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from Formosa.

Smicromyrme norna (Zavattari).

Mutilla norna Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 40, ♂.
Smicromyrme norna Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, Formosa : Taihorin, May, 1909 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from Formosa.

Smicromyrme drupa (Zavattari).

Mutilla drupa Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 41, ♂.
Smicromyrme drupa Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, Formosa : Kankau (Koshun), April 7, 1912 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from Formosa.

Smicromyrme fura fura Mickel.

Smicromyrme fura fura Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 198, ♀.

Holotype.—♀, Philippine Islands : Tangcolan, Bukidnon, Mindanao (*Baker*), in United States National Museum.

Distribution.—Philippine Islands : islands of Luzon, Samar, Sibuyan, Panay, Mindanao and Basilan.

Smicromyrme fura anthracipes Mickel.

Smicromyrme fura anthracipes Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 200, ♀.

Holotype.—♀, Philippine Islands : Banguio, Benguet, Luzon (*Baker*), in United States National Museum.

Distribution.—Known only from the Philippine Islands : island of Luzon.

Smicromyrme decora (Smith).

Mutilla decora Smith, 1879, *Descr. n. Sp. Hymenopt.* : 200, ♀.
Mutilla decora Dalle Torre, 1897, *Cat. Hymen.*, **8** : 30, ♀.
Mutilla decora André, 1903, *Gen. Insect.*, **11** : 39, ♀.

Holotype.—♀, Straits Settlements : Pulo Penang, in British Museum (Natural History).

Distribution.—Known only from the type locality.

I have not had an opportunity to examine the specimens recorded as this species by Magretti (1892) from Burma, and Zavattari (1910) from Java, but there is considerable probability that they are not the same as this species.

Smicromyrme lewisi lewisi nom. n.

Mutilla japonica Cameron, 1900, *Mem. Manchester lit. phil. Soc.*, **44** (15) : 76, ♀ (*nec* Dalle Torre, 1897).
——— *japonica* André, 1903, *Gen. Insect.*, **11** : 70, ♀.
Mutilla japonica Schulz, 1906, *Spolia Hymenopt.* : 158, ♀.

Holotype.—♀, Japan : Hakodate, Hokkaido Island (*George Lewis*), in British Museum (Natural History).

The name *japonica* is preoccupied by Dalle Torre, 1897, so the above new name is proposed for Cameron's species.

The males listed below collected by Mr. Teranishi at Jozankei and Koiwai fm. at the same time as females were collected must certainly be the male sex of *lewisi*. The male has the pronotum maculated with black in the same manner as the female, both sexes were collected very close to the locality where the holotype was originally taken, and for the present at least this is the only species of *Smicromyrme* known from the island of Hokkaido as well as for the entire Japanese islands.

The male heretofore undescribed is as follows:

Entirely black, except certain areas of the thorax as follows: prothorax, mesonotum, scutellum, postscutellum and tegulae, ferruginous, except the pronotum medially, ventral areas of propleurae, and median area of postscutellum, black; abdominal tergites one to three with an apical fringe of pale pubescence, that on tergite one very thin, on two and three moderately thick; mandibles edentate at the apex and with a distinct tooth within near the apex, deeply excised beneath forming a prominent tooth beneath near the base; median triangular area of clypeus slightly elevated and anteriorly with a pair of small, distinct tubercles; scape distinctly bicarinate beneath; first segment of flagellum equal in length to half the length of the second; front with moderate, dense punctures, the vertex obscurely, longitudinally striato-punctate; pronotum, mesonotum and scutellum with sparse, erect, black, pubescence; parapsidal furrows deep and distinct throughout; propodeum deeply reticulate, the various surfaces rounded into one another; tegulae with moderate punctures and sparse, black pubescence; first three abdominal segments with sparse, erect, pale pubescence, the remainder with sparse, black pubescence, except the fourth with the pubescence more or less pale fuscous; second tergite with moderately large, separated punctures becoming somewhat closer laterally; wings subfuscous; calcaria pale. Length, 13 mm.

Allotype.—♂, JAPAN: Jozankei, Hokkaido Island (*C. Teranishi*), in University of Minnesota collection.

Specimens examined.—25 ♀♀, 4 ♂♂, JAPAN: Jozankei, Hokkaido Island, August 4, 1922 (*C. Teranishi*); ♀, JAPAN: Sapporo, Hokkaido Island, July 9, 1922 (*C. Teranishi*); 2 ♀♀, ♂, JAPAN: Koiwai fm., August 20, 1922 (*C. Teranishi*).

Distribution.—JAPAN: island of Hokkaido.

The males vary in length from 9 to 13 mm., the females from 4·5 to 10 mm. The females have been compared with Cameron's holotype of *japonica* and found to be identical.

Smicromyrme lewisi nigricula subsp. n.

♂. Identical in every respect with the subsp. *lewisi* except the body entirely black, and the tegulae very dark testaceous, in part translucent; structure of mandibles, sculpture of clypeus, length of flagellar segments, pubescence and puncturation of body, and colour of wings are otherwise the same as in the preceding subspecies. Length, 9 mm.

Holotype.—♂, JAPAN: Jozankei, Hokkaido Island (*C. Teranishi*), in University of Minnesota collection.

Paratype.—♂, JAPAN: Sapporo, Hokkaido Island, July 4, 1922 (*C. Teranishi*).

The length of the paratype is 6·5 mm. This subspecies has very much the appearance of *guntheri* Zavattari from Formosa, but the clypeus of the latter is not tuberculate and the abdomen while black has very obscure metallic blue reflections in the Formosan species.

Smicromyrme lewisi yanoi nom. n.

Mutilla cameroni Yano, 1932, *Icon. Insect. Japon.*: 326. fig. 635, ♂ and ♀ (*nec* Schulz, 1906).

This subspecies is very similar to subspecies *lewisi*. The females differ in having the thorax almost entirely ferruginous, there being no black spot on the propodeum, and the pronotum marked with black only at the anterior, median margin. The male differs from subsp. *lewisi* in having the postscutellum entirely ferruginous and the black spot on the pronotum much reduced, absent except on the median anterior face.

Holotype and Allotype.—♂ and ♀, JAPAN: islands of Honshu and Kyushu. Location unknown.

Since the name *cameroni* is preoccupied I take pleasure in dedicating this subspecies to Professor Yano who described it originally.

Smicromyrme parva (Brown).

Mutilla parva Brown, 1906, *Philipp. J. Sci.*, **1** : 685, ♀.
Smicromyrme parva Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 203, ♀.

Type.—♀, PHILIPPINE ISLANDS: Manila. Location unknown.

Distribution.—PHILIPPINE ISLANDS: islands of Luzon and Mindanao.

Smicromyrme basalis basalis (Smith).

Mutilla basalis Smith, 1879, *Descr. n. Sp. Hymenopt.* : 200, ♀.
Mutilla basalis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 15, ♀.
Mutilla basalis André, 1903, *Gen. Insect.*, **11** : 38, ♀.
Smicromyrme basalis basalis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 202, ♀.

Holotype.—♀, BORNEO: Sarawak, in British Museum (Natural History).

Specimens examined.—8 ♀♀, BORNEO: Sandakan (*Baker*); ♀, N. BORNEO: Bettotan, near Sandakan, August 17, 1927 (*C. B. K.* and *H. M. P.*).

All but one of the specimens examined were compared with the holotype and found to be identical. I have not examined the specimens recorded from Sumatra by André (1896) but think they are not conspecific with Smith's species.

Distribution.—BORNEO and PHILIPPINE ISLANDS: island of Mindanao.

Smicromyrme basalis annularis Mickel.

Smicromyrme basalis annularis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 203, ♀.

Holotype.—♀, PHILIPPINE ISLANDS: Baguio, Benguet, Luzon (*Baker*), in United States National Museum.

Distribution.—PHILIPPINE ISLANDS: island of Luzon.

Smicromyrme kedahensis nom. n.

Smicromyrme kellyi Pagden, 1934, *J. F.M.S. Mus.*, **17** : 443, ♀ (not ♂).

Holotype.—♀, (UNFEDERATED MALAY STATES): Bukit Panchor, Kedah, July 10, 1929, in British Museum (Natural History).

Distribution.—MALAY PENINSULA.

This is probably not the female sex of the species described by Pagden as *kellyi*, as the male belongs to *Timulla* (*Trogaspidia*). The two sexes were not taken *in copula* but only at the same time and place. Since the male was designated as the holotype, it retains the name *kellyi*, leaving the female without a name, for which I propose *kedahensis*. It is apparently close to *wotani* Zavattari, although I have not had a specimen of the latter to compare with Pagden's paratype. At least one point of difference is that indicated in the key.

Smicromyrme wotani (Zavattari).

Mutilla wotani Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 27, ♀.
Smicromyrme wotani Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 420, ♀.

Lectotype.—♀, FORMOSA : Tainan, August, 1909 (*H. Sauter*), in Deutsches Entomologisches Museum, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

Smicromyrme thia Mickel.

Smicromyrme thia Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 420, ♀.

Holotype.—♀, FORMOSA : Koroton, September 7, 1907 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Smicromyrme hageni (Zavattari).

Mutilla hageni Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 32, ♂.
Smicromyrme hageni Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 417, ♂.

Lectotype.—♂, FORMOSA : Kankau, April 7, 1912 (*H. Sauter*), in Deutsches Entomologisches Institut, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

Smicromyrme bakeri Mickel.

Smicromyrme bakeri Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 212, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Port Princesa, Palawan (*Baker*), in United States National Museum.

Specimens examined.—♂, N. BORNEO : Labuan Island, September 23, 1927 (*C. B. K.* and *H. M. P.*).

Distribution.—Known only from the localities mentioned above.

The specimen from Labuan Island has been compared with the holotype and found to be identical.

Smicromyrme semperi semperi (Ashmead).

Mutilla semperi Ashmead, 1904, *Proc. U.S. Nat. Mus.*, **28** : 135, ♂.
Mutilla semperi Brown, 1906, *Philipp. J. Sci.*, **1** : 689, ♂.
Smicromyrme semperi semperi Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 210, ♂ and ♀.

Holotype.—♂, PHILIPPINE ISLANDS : Manila, in United States National Museum.

Allotype.—♀, PHILIPPINE ISLANDS : Los Banos, Luzon, 1916 (*F. X. Williams*), in University of Minnesota collection.

Distribution.—PHILIPPINE ISLANDS : islands of Luzon, Panay and Negros.

Smicromyrme semperi nigrogastra Mickel.

Smicromyrme semperi nigrogastra Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 212, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Zambales Province, Luzon (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Smicromyrme fluctuata (Smith).

Mutilla fluctuata Smith, 1865, *J. Proc. linn. Soc., Zool.*, **8** : 80, ♂.
Mutilla fluctuata Dalle Torre, 1897, *Cat. Hymen.*, **8** : 41, ♂.
——— *fluctuata* André, 1903, *Gen. Insect.*, **11** : 70, ♂.
Smicromyrme fluctuata Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 204, ♂.

Holotype.—♂, MORTY ISLAND, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—MORTY ISLAND and PHILIPPINE ISLANDS : islands of Samar, Negros and Mindanao.

Smicromyrme zebina (Smith).

Mutilla zebina Smith, 1861, *J. Proc. linn. Soc., Zool.*, **5** : 115, ♀.
Mutilla zebina, Dalle Torre, 1897, *Cat. Hymen.*, **8** : 99, ♀.
Mutilla zebina André, 1903, *Gen. Insect.*, **11** : 41, ♀.
Smicromyrme zebina Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 204, ♂ and ♀.

Holotype.—♀, island of Bachian, in Saunders' coll., Hope Dept. Oxford University.

Allotype.—♂, PHILIPPINE ISLANDS : Los Banos, Luzon, 1916 (*F. X. Williams*), in University of Minnesota collection.

Specimens examined.—2 ♀♀, 3 ♂♂, BORNEO : Sandakan (*Baker*) ; 2 ♂♂, N. BORNEO : Bettotan, near Sandakan, Aug. 2, 5, 1927 (*C. B. K.* and *H. M. P.*).

Distribution.—N. BORNEO ; island of BACHIAN ; and PHILIPPINE ISLANDS : islands of Luzon, Cebu and Mindanao.

Smicromyrme palawanensis Mickel.

Smicromyrme palawanensis Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 206, ♂.

Holotype.—♂, PHILIPPINE ISLANDS : Port Princesa, Palawan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Smicromyrme deidamia (Smith).

Mutilla deidamia Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 83, ♀.
Mutilla pandora Smith, 1858, *J. Proc. linn. Soc., Zool.*, **2** : 85, ♀.
Mutilla pandora André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 67, ♀.
Mutilla deidannia Dalle Torre, 1897, *Cat. Hymen.*, **8** : 30, ♀.
Mutilla pandora Dalle Torre, 1897, *Cat. Hymen.*, **8** : 70, ♀.
Mutilla deidamia André, 1903, *Gen. Insect.*, **11** : 39, ♀.
Mutilla pandora André, 1903, *Gen. Insect.*, **11** : 40, ♀.
Mutilla didannia Schulz, 1906, *Spolia Hymenopt.* : 157, ♀.

Holotype.—♀, BORNEO : Sarawak, in Saunders' coll., Hope Dept. Oxford University. The holotype of *pandora* Smith is in the same collection. I have compared the two holotypes and find them to be identical.

Specimens examined.—8 ♀♀, BORNEO : Sandakan (*Baker*) ; 2 ♀♀, N. BORNEO : Bettotan, near Sandakan, Aug. 2, 10, 1927 (*C. B. K.* and *H. M. P.*). Six of the above females were compared with both of Smith's holotypes.

Distribution.—Known only from BORNEO.

I have not examined the specimen recorded by Zavattari (1913, *a*) from Momeit, but doubt its identity with *deidamia*. The specimen recorded by Zavattari (1913, *b*) from Formosa belongs to the following species.

Smicromyrme triguttata Mickel.

Mutilla pandora Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 31, ♀ (*nec* Smith).
Smicromyrme triguttata Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 421, ♀.

Holotype.—♀, FORMOSA : Taihorin, October, 1910 (*H. Sauter*), in Zoologisches Museum der Universität, Berlin.

Distribution.—Known only from FORMOSA.

Smicromyrme autonoe Mickel.

Smicromyrme autonoe Mickel, 1934, *Philipp. J. Sci.*, **54** (1) : 208, ♀.

Holotype.—♀, PHILIPPINE ISLANDS : Port Princesa, Palawan (*Baker*), in United States National Museum.

Distribution.—Known only from the type locality.

Smicromyrme alberici (Zavattari).

Mutilla alberici Zavattari, 1913, *Arch. f. Naturges.*, **79** A. (3) : 31, ♀.
Smicromyrme alberici Mickel, 1933, *Ann. ent. Soc. Amer.*, **26** : 421, ♀.

Lectotype.—♀, FORMOSA : Tainan, August, 1911 (*H. Sauter*), in Deutsches Entomologisches Museum, Berlin-Dahlem.

Distribution.—Known only from FORMOSA.

Ephutomorpha André.

The genus *Ephutomorpha* was proposed by André (1903) as a provisional genus for all Australian MUTILLIDAE, and since that time has been used by various authors in a similar way. The genus is used here in the same sense. The Australian Mutillid fauna, however, is a very heterogeneous assemblage of species and a number of genera are represented. A detailed study of the Australian species and their generic relationships is necessary before any analysis of the geographic distribution of MUTILLIDAE in the Australian region can be made. The species which follow are assigned to *Ephutomorpha* solely because their phylogenetic affinities are with the MUTILLIDAE of Australia.

Key to the Species.

♂♂.

1. First and second abdominal segments with an apical fringe of dense, white plumose pubescence . . . . *damia* (Smith).
   Pubescence of entire body composed of simple hairs, entirely without any plumose pubescence . . . . 2.
2. Cell 2nd $R_1 + R_2$ broadly, either squarely or obliquely truncate at the apex 6.
   Cell 2nd $R_1 + R_2$ acute at the apex . . . . 3.
3. Cell R_5 equal in length to cell R + 1st R_1 ; apical two-thirds of wings fuscous *azurea* (Mantero).
   Cell R_5 one-third to one-half the length of cell R + 1st R_1 ; wings subhyaline or with a median transverse fuscous fascia . . . . 4.
4. First abdominal segment petiolate; tegulae closely punctate; wings without a dark fascia medially . . . . 5.
   First abdominal segment entirely sessile; tegulae very sparsely punctate; cell R_5 about half as large as cell R + 1st R_1 ; wings hyaline with a dark fuscous fascia extending from anterior to inner margins through the stigma, the apical margin also slightly infuscated . . . *agilis* (Smith).

5. Head, thorax and abdomen, dark metallic blue; cell R_5 one-third as large as cell R + 1st R_1 . . . . *carinata* (Smith).
Head, thorax and abdomen, black; cell R_5 half as large as cell R + 1st R_1 *pagdeni* sp. n.
6. Cell R_5 equal in length to cell R + 1st R_1; head, thorax and first two abdominal segments bright metallic green; flagellum mostly black . . 8.
Cell R_5 slightly more than half as long as cell R + 1st R_1; head and thorax dark metallic purple or blue . . . . 7.
7. Head and thorax dark metallic purple; abdomen dark metallic blue *fulgida* (André).
Head and thorax mostly metallic blue; abdomen mostly violaceous *paradisiaca* Zavattari.
8. Scape and legs testaceo-ferruginous . . . . 9.
Scape very dark ferruginous; femora bright metallic green; tergites 3–5 greenish bronze, clothed with golden ferruginous pubescence *splendida* (Smith).
9. Abdominal segments 3–6 dark purple, clothed with black pubescence *mirabilis* (Smith).
Abdominal segments 3–6 metallic green, clothed with golden pubescence *pallidipes* (André).

♀♀.

1. Eyes round, very convex, prominent . . . . 2.
Eyes ovate, not strongly convex and prominent; first segment of the abdomen short, sharply truncate anteriorly, presenting a broad, anterior surface at right angles to the dorsum of the abdomen; thorax broad anteriorly, much narrowed posteriorly; external, apical, tibial spine at the apex of a slender, cylindrical process . . . . . *carinata* (Smith).
2. First abdominal segment sessile with the second . . . . 3.
First abdominal segment more or less petiolate . . . . 11.
3. Pygidial area entirely absent, not defined laterally . . . . 4.
Pygidial area distinct, defined laterally by a carina . . . . 6.
4. Lateral margins of pronotum very deeply incised; head and thorax black *incisa* André.
Lateral margins of pronotum not incised, feebly crenulate; head bluish-green . . . . 5.
5. Posterior and intermediate tibiae with two rows of spines externally *biròi* André.
Posterior and intermediate tibiae armed only with three spines *praestans* André.
6. Calcaria black; thorax entirely black . . . . *caledonica* (André).
Calcaria pale; thorax black or ferruginous. . . . . 7.
7. Thorax entirely black; distal margin of first and second abdominal tergites each with a pair of subquadrate pale spots, the colour both integumental and pubescent; pygidum longitudinally striate. . . . . *pagdeni* sp. n.
Thorax entirely ferruginous; first and second abdominal tergites without paired, distal, pale spots . . . . 8.
8. Intermediate and posterior tibiae strongly spined externally, with two distinct rows of spines . . . . *extranea* (André).
Intermediate and posterior tibiae weakly spined externally, with only one row of spines. 9.
9. Anterior two-thirds of first abdominal tergite black, the posterior third pale yellow, the colour integumental . . . . *sumbawae* (Zavattari).
First abdominal tergite either entirely ferruginous or entirely blackish, not maculated apically with pale yellow . . . . 10.

10. Pygidium longitudinally striate; legs black . . . . *thera* (Smith).
Pygidium weakly granulate; legs ferruginous . . . . . . *curta* (André).

11. Thorax as broad as long, lateral margins of mesonotum not at all dentate; external, apical, tibial spine not at the apex of a slender process; pygidial area longitudinally striate . . . . *aerata* (André).
Thorax longer than broad; lateral margins of mesonotum with a large, prominent tooth; external, apical tibial spine at the apex of a slender, cylindrical process; pygidial area not striate . . . . 12.

12. Second tergite evenly convex throughout, without elevated prominences basally; dorsum of thorax with moderately large, mostly separate punctures . . . . *fulgida* (André).
Antero-lateral areas of second tergite more or less gibbose; dorsum of thorax with very large, deep, coarse, more or less confluent punctures . 13.

13. Antero-lateral prominences of second tergite high, almost angulate; second tergite with pale pubescence only at the lateral portions of the apical fringe; thorax metallic purple in colour . . . . . . *inclyta* (André).
Antero-lateral prominences of second tergite low, rounded; second tergite with a complete, apical band of pale pubescence; thorax metallic blue-green . . . . *paradisiaca* Zavattari.

Ephutomorpha carinata (Smith).

Mutilla carinata Smith, 1859, *J. Proc. linn. Soc., Zool.*, **3** : 150, ♂ and ♀.
Mutilla carinata Dalle Torre, 1897, *Cat. Hymen.*, **8** : 21, ♀.
Ephutomorpha carinata André, 1903, *Gen. Insect.*, **11** : 49, ♀.

Holotype and Allotype.—♂ and ♀, ISLAND OF ARU, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

André (1896), Mantero (1900) and Zavattari (1913) have recorded this species from various places in New Guinea, but it is evident from the published comments on the material they examined that they had before them representatives of at least one, and probably several, undescribed related species.

Ephutomorpha azurea (Mantero).

Mutilla (*Ephuta*) *azurea* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 584, ♂.
Ephutomorpha azurea André, 1903, *Gen. Insect.*, **11** : 49, ♂.

Holotype.—♂, NEW GUINEA : Moroka, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from NEW GUINEA.

Ephutomorpha agilis (Smith).

Mutilla agilis Smith, 1865, *J. Proc. linn. Soc., Zool.*, **8** : 79, ♂.
Mutilla agilis Dalle Torre, 1897, *Cat. Hymen.*, **8** : 7, ♂.
——— *agilis* André, 1903, *Gen. Insect.*, **11** : 72, ♂.
Ephutomorpha gaudens Zavattari, 1913, *Boll. Soc., ent. ital.*, **45** : 111, ♂.

Holotype.—♂, NEW GUINEA, in Saunders' coll., Hope Dept. Oxford University. Zavattari's type of *gaudens* is in the Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from New Guinea.

I have not examined Zavattari's type, but his description of *gaudens* agrees with my notes describing Smith's *agilis*, and I believe the synonymy is correct.

Ephutomorpha caledonica (André).

Mutilla (*Sphaerophthalma*) *caledonica* André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 96, ♀.
Ephutomorpha caledonica André, 1903, *Gen. Insect.*, **11** : 49, ♀.

Lectotype.—♀, NEW CALEDONIA : Noumea, in Muséum Nationale d'Histoire Naturelle, Paris.

Distribution.—Known only from NEW CALEDONIA.

Ephutomorpha incisa André.

Ephutomorpha incisa André, 1905, *Z. Hymen. Dipt.*, **5** : 275, ♀.

Holotype.—♀, NEW GUINEA : Huon Gulf, in Hungarian National Museum, Budapest.

Distribution.—Known only from the type locality.

Ephutomorpha praestans André.

Ephutomorpha praestans André, 1905, *Z. Hymen. Dipt.*, **5** : 266, ♀.

Holotype.—♀, NEW GUINEA : Erima, in Hungarian National Museum, Budapest.

Distribution.—Known only from the type locality.

Ephutomorpha birói André.

Ephutomorpha birói André, 1905, *Z. Hymen. Dipt.*, **5** : 273, ♀.

Holotype.—♀, NEW GUINEA : Huon Gulf, in Hungarian National Museum, Budapest.

Distribution.—Known only from the type locality.

Ephutomorpha pagdeni sp. n.

♂. Entirely black; head as wide as the thorax, not well developed behind the eyes; eyes round, prominent; first abdominal segment long, distinctly petiolate; tegulae densely punctate; wings subhyaline; cell 2nd $R_1 + R_2$ acute at the apex; cell R_5 half as large as cell R + 1st R_1; calcaria pale. Length, 7·5 mm. *Head* entirely black, clothed with very sparse, erect and suberect, intermixed, pale and dark pubescence, the dark pubescence more obvious on the vertex; mandibles slender, edentate at the apex, and with only a small, obscure tooth within near the apex, not excised beneath; clypeus finely punctate; antennal tubercles distinctly separated; scape finely, densely punctate; first segment of flagellum very slightly shorter than the second; antennal scrobes not carinate above; front with moderate, shallow, dense, confluent punctures; vertex and genae with moderate, deep, contiguous punctures; relative widths of head and thorax at the tegulae, 2·1–2·4. *Thorax* entirely black, clothed with very sparse, erect and suberect pubescence, that on the pronotum, mesonotum and scutellum, black, elsewhere pale glittering; pronotum mesonotum and scutellum with moderate, deep punctures, distinct but more or less contiguous on the pronotum and mesonotum, close and contiguous on the scutellum; dorsum and posterior face of propodeum shallowly reticulate; propleurae finely punctate; mesopleurae with a deep, transverse furrow separating the dorsal and ventral areas, with moderate, confluent punctures anteriorly, glabrous impunctate posteriorly; metapleurae glabrous, impunctate; sides of propodeum glabrous, obscurely, shallowly reticulate posteriorly; tegulae small, strongly convex, densely punctate, clothed with pale pubescence. *Abdomen* black, clothed with very sparse, erect and appressed, intermixed, pale glittering and black pubescence, except the last two segments with the pubescence entirely black; first segment long and distinctly petiolate; first tergite with moderate, distinct, well-separated punctures; second tergite evenly punctate with distinct, separated, moderate punctures, the latter becoming slightly smaller posteriorly; tergites 3–6 with small, distinct, almost contiguous punctures; last tergite with a distinct, granulate pygidial area; first sternite slightly elevated along the median, longitudinal line producing a low ridge on the anterior three-fourths; second sternite with well-separated, moderate punctures; sternites 3–6 with fine punctures at the distal margin; hypopygium with small, close punctures. *Wings* subhyaline with cell 2nd $R_1 + R_2$ slightly darker, and acute at the apex; cell R_5 half as large as cell $R +$ 1st R_1; cell R_4 and 1st M_2 entirely absent. *Legs* black, sparsely clothed with pale, glittering, pubescence; calcaria pale brown.

♀. Black, except mandibles, scape and legs mostly testaceous, the vertex and mesonotum each with a pair of obscure, pale pubescent spots, the distal margin of the first and second abdominal tergites each with a pair of conspicuous, subquadrate, pale spots, the colour integumental and pubescent, and the distal margin of the fifth tergite with a pale pubescent band; first abdominal segment completely sessile; pygidial area longitudinally striate anteriorly, glabrous on the distal third. Length, 4·5 mm. *Head* black, except the mandibles and scape testaceous, clothed with sparse, fuscous pubescence, except the vertex with a pair of obscure spots of sparse, pale glittering pubescence contiguous with the eyes; mandibles slender, edentate at the apex, with only a small, obscure tooth within near the apex, not excised beneath; antennal tubercles distinctly separated; first segment of flagellum longer than the second but shorter than the second and third united; front, vertex and genae with small, very dense, deep punctures; relative widths of head and thorax, 2·1–1·9. *Thorax* entirely black, hexagonal in outline, as broad as long, the dorsum clothed with sparse, fuscous pubescence, except the mesonotum with a pair of obscure spots of sparse, pale glittering pubescence, the spots almost contiguous at the median line, elsewhere the thorax with sparse, pale glittering pubescence; dorsum of thorax with small, very dense, deep punctures; posterior face of propodeum with small, distinct, separated punctures; propodeal spiracles distinct; propleurae finely punctate; mesopleurae anteriorly glabrous with shallow, obscure, fine punctures, the ventro-dorsal ridge with small, deep, confluent punctures, and the posterior area together with the metapleurae glabrous with obscure, shallow, fine punctures; sides of propodeum glabrous, impunctate. *Abdomen* black, except the pygidial area and all the sternites dark testaceous; anterior face of first tergite with very sparse, small punctures; the dorsal face with small, very dense punctures; first tergite clothed with sparse, pale fuscous, erect pubescence, and with a pair of pale subquadrate spots on the dorsal face, the colour integumental, and appressed, pale, glittering pubescence, the spots separated by half their transverse diameter; second tergite with small, very dense punctures throughout, clothed with sparse, erect and appressed blackish pubescence, except towards the lateral margins the pubescence pale, and with a pair of subquadrate, pale spots at the distal margin, the colour integumental and pubescent as in the spots on the first tergite, but larger than on the first tergite, and separated by half their transverse diameter; tergites 3–5 with very small, dense punctures, clothed with sparse, blackish pubescence, except the distal margin of the fifth with an obscure band of pale pubescence, the band broadest and most obvious medially; pygidial area longitudinally striate anteriorly, glabrous, unsculptured on the distal third; first sternite with a median, longitudinal carina on the anterior half; second sternite with moderate, distinct, more or less contiguous punctures; sternites 3–5 with very small, close punctures at the distal margin; last sternite with small, close punctures. *Legs* testaceous, except the distal half of the femora infuscated, clothed with sparse, pale glittering pubescence; tibiae with a single row of spines; calcaria pale testaceous.

Holotype.—♂, British Solomon Islands : Teloura, Berande, Guadalcanal Is., February 6, 1934, on Zingiberaceae (*H. T. Pagden*), in University of Minnesota collection.

Allotype.—♀, British Solomon Islands: Teloura, Berande, Guadalcanal Is., February 6, 1934, on Zingiberaceae (*H. T. Pagden*), in University of Minnesota collection.

Paratypes.—♂, 14 ♀♀, British Solomon Islands: Teloura, Berande, Guadalcanal Is., February 6, 1934, on Zingiberaceae (*H. T. Pagden*); ♀, Lavoro, Guadalcanal Is., February 16, 1934, on leaves wild fig (*H. T. Pagden*); ♀ (Televo), Lavoro, Guadalcanal Is., February 20, 1934, on Zingiberaceae (*H. T. Pagden*); ♀, Lunga, Guadalcanal Is., March 29, 1934 (*R. A. Lever*); ♀, Kaukau, Guadalcanal Is., May 20, 1933 (*M. Willows, Jr.*), Crocker Exped.; ♀, Su'u, Malaita Is., May 24, 1934 (*R. A. Lever*); ♀, Kaukau, Guadalcanal Is., August 12, 1934 (*R. A. Lever*); ♀, Kaukau, Guadalcanal Is., August 16, 1934 (*R. A. Lever*); 2 ♂♂, 5 ♀♀, Kaukau, Guadalcanal Is., August 20, 1934 (*R. A. Lever*); ♀, Su'u, Malaita Is., August 15, 1934, on fern frond (*H. T. Pagden*); 2 ♂♂, 2 ♀♀, Berande, Guadalcanal Is., August 26, 1934 (*H. T. Pagden*); ♂, Berande, Guadalcanal Is., August 27, 1934, on wild fig (*H. T. Pagden*); ♀, Veisali-Marovovo, August 29, 1934 (*H. T. Pagden*); ♂, Lavoro, Guadalcanal Is., August 31, 1934, on wild fig (*H. T. Pagden*); ♂, Araligo-Doma, Guadalcanal Is., September 5, 1934 (*H. T. Pagden*); ♀, Somata, Russell Is., September 15, 1934 (*R. A. Lever*).

The males vary in length from 4·5 to 9 mm., the females from 4 to 7 mm. Since no other species of this genus has been collected in the Solomon Islands there can be little doubt that these are the two sexes of the same species.

Ephutomorpha extranea (André).

Mutilla (*Sphaerophthalma*) *extranea* André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 93, ♀.
Mutilla (*Ephuta*) *extranea* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 587, ♀.
Ephutomorpha extranea André, 1903, *Gen. Insect.*, **11** : 50, ♀.

Holotype.—♀, New Guinea: mer. or. (*Dr. L. Loria*), in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

Ephutomorpha sumbawae (Zavattari).

Mutilla sumbawae Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 85, ♀.

Holotype.—♀, Island of Sumbawa, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from the type locality.

Ephutomorpha thera (Smith).

Mutilla thera Smith, 1864, *J. Proc. linn. Soc., Zool.*, **7** : 24, ♀.
Mutilla thera Dalle Torre, 1897, *Cat. Hymen.*, **8** : 91, ♀.

Holotype.—♀, Ceram, in Saunders' coll., Hope Dept. Oxford University.

Distribution.—Known only from the type locality.

Ephutomorpha curta (André).

Mutilla (*Sphaerophthalma*) *curta* André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 92, ♀.
?*Mutilla* (*Ephuta*) *curta* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 587, ♀.
Ephutomorpha curta André, 1903, *Gen. Insect.*, **11** : 49, ♀.
?*Ephutomorpha curta* 1913, Zavattari, *Boll. Soc. ent. ital.*, **45** : 105, ♀ (in part).

Holotype.—♀, Amboina (*Dr. O. Beccari*), in Museo Civico di Storia naturale, Genoa.

Specimens examined.—♀, CERAM : Piroe, January, 1909 (*F. Muir*); compared with holotype.

Distribution.—AMBOINA; CERAM; and possibly BOURO.

The specimens recorded from New Guinea by André (1896) and Zavattari (1913) appear to be at least subspecifically distinct.

Ephutomorpha aerata (André).

Mutilla (*Sphaerophthalma*) *aerata* André, 1896, *Ann. Mus. civ. Stor. nat. Genova,* (2) **17** : 87, ♀.
Mutilla (*Ephuta*) *aerata* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova,* **40** : 586, ♀.
Ephutomorpha aerata André, 1903, *Gen. Insect.,* **11** : 49, ♀.

Holotype.—♀, NEW GUINEA : Moroka (*Dr. Loria*), in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from NEW GUINEA.

Ephutomorpha splendida (Smith).

Mutilla splendida Smith, 1879, *Descr. n. Sp. Hymenopt.* : 207, ♂.
Mutilla (*Sphaerophthalma*) *mirabilis* var. *splendida* André, 1896, *Ann. Mus. civ. Stor. nat. Genova,* (2) **17** : 90, ♂.
Mutilla splendida Dalle Torre, 1897, *Cat. Hymen.,* **8** : 88, ♂.
Mutilla (*Ephuta*) *mirabilis* var. *splendida* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova,* **40** : 586, ♂.
Ephutomorpha splendida André, 1903, *Gen. Insect.,* **11** : 51, ♂.

Holotype.—♂, NEW GUINEA, in British Museum (Natural History).

Distribution.—Known only from NEW GUINEA.

Ephutomorpha mirabilis (Smith).

Mutilla mirabilis Smith, 1864, *J. Proc. linn. Soc., Zool.,* **7** : 24, ♂.
Mutilla (*Sphaerophthalma*) *mirabilis* var. *cyaneopartita* André, 1896, *Ann. Mus. civ. Stor. nat. Genova,* (2) **17** : 91, ♂.
Mutilla mirabilis Dalle Torre, 1897, *Cat. Hymen.,* **8** : 68, ♂.
Mutilla (*Ephuta*) *mirabilis* var. *cyaneopartita* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova,* **40** : 586, ♂.
Ephutomorpha mirabilis André, 1903, *Gen. Insect.,* **11** : 50, ♂.
Ephutomorpha mirabilis var. *cyaneopartita* André, 1903, *Gen. Insect.,* **11** : 50, ♂.
Ephutomorpha mirabilis var. *cyaneopartita* Zavattari, 1913, *Boll. Soc. ent. ital.,* **45** : 111, ♂.

Lectotype.—♂, ISLAND OF WAIGIOU, in Saunders' coll., Hope Dept. Oxford University. The type of André's variety *cyaneopartita* is in the Museo Civico di Storia naturale, Genoa.

Distribution.—ISLAND OF WAIGIOU; and NEW GUINEA.

There are two specimens of this species in the Saunders' collection, one of which is labelled "cotype." The latter was compared with the lectotype and found to be identical; it has also been compared with André's type of the variety *cyaneopartita*, and these two were found to be identical.

Ephutomorpha pallidipes (André).

Mutilla (*Sphaerophthalma*) *mirabilis* var. *pallidipes* André, 1896, *Ann. Mus. civ. Stor. nat. Genova,* (2) **17** : 91, ♂.
Mutilla (*Ephuta*) *mirabilis* var. *pallidipes* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova,* **40** : 586, ♂.
Ephutomorpha mirabilis var. *pallidipes* André, 1903, *Gen. Insect.,* **11** : 50, ♂.

Holotype.—♂, NEW GUINEA : Bujakori (*Dr. Loria*), in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from NEW GUINEA.

Ephutomorpha fulgida (André).

Mutilla (*Sphaerophthalma*) *fulgida* André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2), **17** : 84, ♂ and ♀.
Mutilla (*Ephuta*) *fulgida* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 584, ♂ and ♀.
Ephutomorpha fulgida André, 1903, *Gen. Insect.*, **11** : 50, ♀.

Lectotype.—♀, New Guinea : Bujakori, Paumomu river (*Dr. Loria*), in Museo Civico di Storia naturale, Genoa.

Allotype.—♂, New Guinea : Paumomu river (*Dr. Loria*), in the same museum.

Distribution.—Known only from New Guinea.

Ephutomorpha inclyta (André).

Mutilla (*Sphaerophthalma*) *inclyta* André, 1896, *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 82, ♀.
Mutilla (*Ephuta*) *inclyta* Mantero, 1900, *Ann. Mus. civ. Stor. nat. Genova*, **40** : 584, ♀.
Ephutomorpha inclyta André, 1903, *Gen. Insect.*, **11** : 50, ♀.

Holotype.—♀, New Guinea : Paumomu river (*Dr. Loria*), in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from New Guinea.

Ephutomorpha paradisiaca Zavattari.

Ephutomorpha paradisiaca Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 106, ♂ and ♀.

Holotype and Allotype.—♂ and ♀, New Guinea : Humboldt Bay, in Museo Civico di Storia naturale, Genoa.

Distribution.—Known only from New Guinea.

Ephutomorpha damia (Smith).

Mutilla damia Smith, 1864, *J. Proc. linn. Soc., Zool.*, **7** : 24, ♂.
Mutilla damia Dalle Torre, 1897, *Cat. Hymen.*, **8** : 29, ♂.
——— *damia* André, 1903, *Gen. Insect.*, **11** : 70, ♂.

Holotype.—♂, Ceram, in Saunders' coll., Hope Dept. Oxford University.

Specimens examined.—♂, Ceram ; compared with type.

Distribution.—Known only from the type locality.

Differs from all other described species from the Oceanic region in the plumose pubescence of the abdomen.

Species unknown to me.

Ephutomorpha fausta (Smith).

Mutilla fausta Smith, 1864, *J. Proc. linn. Soc., Zool.*, **7** : 25, ♀.
Mutilla fausta Dalle Torre, 1897, *Cat. Hymen.*, **8** : 39, ♀.
Ephutomorpha fausta André, 1903, *Gen. Insect.*, **11** : 50, ♀.

Holotype.—♀, Mysol. Location unknown.

The type specimen of this species should be in the Saunders' coll. in the Hope Dept. at Oxford University, but I was not able to find it there. It is apparently lost. The species is unquestionably an *Ephutomorpha* and ought to be readily recognised in material from Mysol.

Ephutomorpha manteroi Zavattari.

Ephutomorpha manteroi Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 109, ♂.

Holotype.—♂, New Guinea : Humboldt Bay, in Museo Civico di Storia naturale, Genoa.

Zavattari states that this species is related to *azurea* Mantero. I have not examined his type specimen.

Ephutomorpha novo-guineana Zavattari.

Ephutomorpha novo-guineana Zavattari, 1913, *Boll. Soc. ent. ital.*, **45** : 113, ♂.

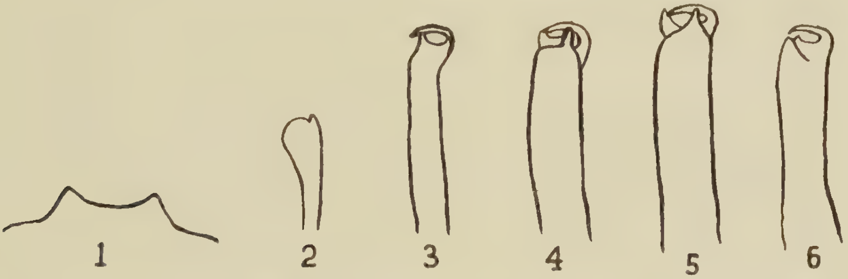
Holotype.—♂, NEW GUINEA : Humboldt Bay, in Museo Civico di Storia naturale, Genoa.

SPECIES INCORRECTLY RECORDED FROM THE PACIFIC ISLANDS.

Ephutomorpha morosa (Westwood).

Mutilla morosa Westwood, 1843, *Arcana Ent.*, **2** : 19, pl. 54, fig. 1, ♂.

The males recorded from New Guinea by Mantero (1900) are probably not the same as Westwood's species, which is known only from Australia.



FIGS. 1–6.—Fig. 1, *Squamulotilla clypealis* sp. n., anterior margin of clypeus; fig. 2, *Timulla* (*Trogaspidia*) *erato* sp. n., calcarium of anterior tibiae. Right uncus of genitalia of: fig. 3, *T.* (*T.*) *tethys tethys* Mickel subsp. n.; fig. 4, *T.* (*T.*) *t. prodiga* subsp. n.; fig. 5, *T.* (*T.*) *t. melanesia* subsp. n.; fig. 6, *T.* (*T.*) *sarawaka* sp. n.

GEOGRAPHICAL CATALOGUE OF SPECIES.

JAPAN.

Squamulotilla ardescens (Smith). ♀.
Cystomutilla ? teranishii Mickel. ♀.
Mutilla europaea mikado (Cameron). ♀.
Timulla (*Trogaspidia*) *concava* Mickel. ♂.
T. (*T.*) *disparilis* Mickel. ♂.
T. (*T.*) *insidiator* (Smith). ♀.
T. (*T.*) *pustulata* (Smith). ♂.
T. (*T.*) *taihorina nipponica* Mickel. ♀.
Smicromyrme lewisi lewisi Mickel. ♂ and ♀.
S. lewisi nigricula Mickel. ♂.
S. lewisi yanoi Mickel. ♂ and ♀.

FORMOSA.

Myrmilla hoozana Zavattari. ♂.
Squamulotilla carinulifera (André). ♀.
S. erdae (Zavattari). ♀.
S. formosana (Zavattari). ♂.
S. sauteri (Zavattari). ♀.
S. trituberculata Mickel. ♀.
S. tumidula Mickel. ♂.
Odontomutilla taiwaniana Zavattari. ♂ and ♀.
Timulla (*Trogaspidia*) *concava* Mickel. ♂.
T. (*T.*) *denotata* Mickel. ♂.
T. (*T.*) *disparilis* Mickel. ♂.
T (*T.*) *elpinice* Mickel. ♂.
T. (*T.*) *formosana* (Matsumura). ♂ and ♀.
T. (*T.*) *friekae discrepans* Mickel. ♂.
T. (*T.*) *friekae friekae* (Zavattari). ♂.
T. (*T.*) *gutrunae* (Zavattari). ♂.
T. (*T.*) *logei* (Zavattari). ♀.
T. (*T.*) *minae* (Zavattari). ♀.
T. (*T.*) *orientalis taiwanensis* Mickel. ♂.

T. (*T.*) *pfafneri* (Zavattari). ♀.
T. (*T.*) *philippinensis amartana* (Zavattari). ♂ and ♀.
T. (*T.*) *rapa* (Zavattari). ♂.
T. (*T.*) *repraesentoides* Mickel. ♀.
T. (*T.*) *rhea* Mickel. ♂.
T. (*T.*) *suspiciosa discolor* Mickel. ♂.
T. (*T.*) *taihorina taihorina* Mickel. ♀.
Smicromyrme alberici (Zavattari). ♀.
S. drola (Zavattari). ♂.
S. drupa (Zavattari). ♂.
S. guntheri (Zavattari). ♂.
S. hageni (Zavattari). ♂.
S. naja (Zavattari). ♂.
S. norna (Zavattari). ♂.
S. strandi (Zavattari). ♂.
S. serpa (Zavattari). ♂.
S. thalia Mickel. ♀.
S. thia Mickel. ♀.
S. triguttata Mickel. ♀.
S. wotani (Zavattari). ♀.

PHILIPPINE ISLANDS.

Squamulotilla byblis Mickel. ♀.
S. concava Mickel. ♂.
S. deserta (Smith). ♀.
S. dictynna Mickel. ♂.
S. disjuncta Mickel. ♂.
S. eminula Mickel. ♂.
S. fucosa Mickel. ♀.
S. galatea Mickel. ♀.
S. imparilis Mickel. ♂.
S. oblectabilis Mickel. ♀.
S. ocypote Mickel. ♂.
S. roxane Mickel. ♂.
S. subdebilis Mickel. ♂.
S. subtriangularis Mickel. ♀.
S. sulpicilla Mickel. ♂.
S. teuta teuta Mickel. ♂.
S. teuta vicinaria Mickel. ♂.
S. umbrosa Mickel. ♂.
Odontomutilla andromeda Mickel. ♂ and ♀.
O. familiaris familiaris (Smith). ♂ and ♀.
O. pedaria Mickel. ♂ and ♀.
Timulla (*Trogaspidia*) *bakeri* Mickel. ♂.
T. (*T.*) *depressula* Mickel. ♂.
T. (*T.*) *eremita eremita* Mickel. ♂ and ♀.
T. (*T.*) *eremita umbra* Mickel. ♂ and ♀.
T. (*T.*) *fortuita fortuita* Mickel. ♂.
T. (*T.*) *ira palawana* Mickel. ♂.
T. (*T.*) *luzonica luzonica* (Radoskowski). ♂.
T. (*T.*) *luzonica panayensis* Mickel. ♂.
T. (*T.*) *manilensis* (Brown). ♀.
T. (*T.*) *minor islandica* Mickel. ♂ and ♀.
T. (*T.*) *minor minor* (Ashmead). ♂ and ♀.
T. (*T.*) *minor princesa* Mickel. ♂.
T. (*T.*) *minor tayabasensis* Mickel. ♂ and ♀.
T. (*T.*) *minor visayanae* Mickel. ♂ and ♀.
T. (*T.*) *minor whiteheadi* Mickel. ♂.
T. (*T.*) *nigerrima* Mickel. ♂.
T. (*T.*) *ovatula aurifera* Mickel. ♀.
T. (*T.*) *ovatula ovatula* Mickel. ♀.
T. (*T.*) *philippinensis itambusa* (Cockerell). ♂.
T. (*T.*) *philippinensis philippinensis* (Smith). ♂ and ♀.
T. (*T.*) *philippinensis williamsi* Mickel. ♀.
T. (*T.*) *proserpina proserpina* (Smith). ♀.
T. (*T.*) *proserpina tibiata* Mickel. ♀.
T. (*T.*) *proserpina viscaya* Mickel. ♀.
T. (*T.*) *sticticornis nigridia* Mickel. ♂.
T. (*T.*) *sticticornis sticticornis* Mickel. ♂.
T. (*T.*) *tegularia* Mickel. ♂.
T. (*T.*) *temeraria* Mickel. ♂.
T. (*T.*) *tethys tethys* Mickel. ♂.
Smicromyrme autonoe Mickel. ♀.
S. bakeri Mickel. ♂.
S. basalis annularis Mickel. ♀.
S. basalis basalis (Smith). ♀.
S. caerulea Mickel. ♂.
S. fluctuata (Smith). ♂.
S. fura anthracipes Mickel. ♀.
S. fura fura Mickel. ♀.
S. hyale Mickel. ♀.
S. ilerda sparsilis Mickel. ♂.
S. lavinia atrata Mickel. ♂.
S. lavinia lavinia Mickel. ♂.
S. palawanensis Mickel. ♂.
S. parva (Brown). ♀.
S. semperi melanogastra Mickel. ♂.
S. semperi semperi (Ashmead). ♂ and ♀.
S. viriata nitela Mickel. ♂.
S. viriata viriata Mickel. ♂.
S. zebina (Smith). ♂ and ♀.

BORNEO.

Squamulotilla aesyca (Cameron). ♀.
S. calliopeia Mickel. ♂.
S. cardea Mickel. ♀.

S. clypealis Mickel. ♂.
S. palaca (Cameron). ♂.
S. sulpicilla Mickel. ♂.
S. venatrix Mickel. ♀.
Rhopalomutilla oceanica Mickel. ♂ and ♀.
Odontomutilla aspratilis Mickel. ♂.
O. cassiope (Smith). ♂ and ♀.
O. familiaris familiaris (Smith). ♂ and ♀.
O. grossa Mickel. ♀.
O. herpa (Cameron). ♂.
O. pompalis Mickel. ♀.
O. rubrocapitata Mickel. ♂.
O. thymele Mickel. ♀.
O. unimaculata (Smith). ♀.
Timulla (*Trogaspidia*) *agapeta* (Cameron). ♂.
T. (*T.*) *bagrada* (Cameron). ♂.
T. (*T.*) *cydippe* Mickel. ♂.
T. (*T.*) *depressicornis* Mickel. ♂.
T. (*T.*) *dercetis* Mickel. ♂.
T. (*T.*) *erato* Mickel. ♂.
T. (*T.*) *fortuita nebulosa* Mickel. ♂.
T. (*T.*) *hylonome* Mickel. ♂.
T. (*T.*) *ira ira* (Cameron). ♂.
T. (*T.*) *lodina* (Cameron). ♀.
T. (*T.*) *mamblia* (Cameron). ♀.
T. (*T.*) *minor sandakanensis* Mickel. ♂ and ♀.
T. (*T.*) *nedyme* Mickel. ♂.
T. (*T.*) *olbia* (Cameron). ♂.
T. (*T.*) *proserpina proserpina* (Smith). ♀.
T. (*T.*) *psecas* Mickel. ♀.
T. (*T.*) *rubrocyanea* Mickel. ♂.
T. (*T.*) *sarawaka* Mickel. ♂.
T. (*T.*) *saturnia samawangensis* Mickel. ♂.
T. (*T.*) *shelfordi* Mickel. ♂.
T. (*T.*) *sibylla* (Smith). ♀.
T. (*T.*) *spatale* Mickel. ♂.
T. (*T.*) *suspiciosa suspiciosa* (Smith). ♂.
T. (*T.*) *tethys prodiga* Mickel. ♂.
Smicromyrme annexa (Cameron). ♂.
S. bakeri Mickel. ♂.
S. basalis basalis (Smith). ♀.
S. caecina (Cameron). ♂.
S. calliope (Smith). ♀.
S. dardanus dardanus (Smith). ♂.
S. dardanus salacia Mickel. ♂.
S. deidamia (Smith). ♀.
S. delia Mickel. ♀.
S. devia (Cameron). ♂.
S. gracillima (Smith). ♂.
S. ilerda ilerda (Cameron). ♂.
S. meator Mickel. ♂.
S. neaera Mickel. ♀.
S. punctinota Mickel. ♂.
S. runcina (Zavattari). ♂.
S. scitula Mickel. ♂.
S. volupia Mickel. ♂.
S. zavattarii Mickel. ♂.
S. zebina (Smith). ♂ and ♀.

MALAY PENINSULA.

Squamulotilla arundinacea Pagden. ♀.
S. malica (Zavattari). ♀.
S. opipara (Zavattari). ♀.
S. perakensis Pagden. ♀.
S. selangorensis Pagden. ♀.
Odontomutilla familiaris familiaris (Smith). ♂ and ♀.
O. haematocephala (André). ♂.
O. urania (Smith). ♀.
Timulla (*Trogaspidia*) *circumcincta* (André). ♀.
T. (*T.*) *kellyi* Pagden. ♂.
T. (*T.*) *krianae* Pagden. ♂.
T. (*T.*) *oryzae* Pagden. ♂ and ♀.
T. (*T.*) *pagdeni pagdeni* Mickel. ♂.
T. (*T*). *pendleburyi* Pagden. ♂ and ♀.
T. (*T.*) *philippinensis malayana* (Cameron). ♂.
T. (*T.*) *philippinensis singapora* Mickel. ♂.
T. (*T.*) *saturnia saturnia* Mickel. ♂.
T. (*T.*) *skeati* (Cameron). ♀.
Smicromyrme decora (Smith). ♀.
S. kedahensis Mickel. ♀.

SUMATRA.

Squamulotilla multidentata (André). ♀.
Odontomutilla familiaris anonyma (Kohl). ♀.
Timulla (*Trogaspidia*) *circumcincta* (André). ♀.
T. (*T.*) *stella* (Zavattari). ♂.
T. (*T.*) *sumatrensis* (André). ♂.

JAVA.

Squamulotilla muiri Mickel. ♂.
Odontomutilla subinterrupta Zavattari. ♂.
Timulla (*Trogaspidia*) *amans* (André). ♂ and ♀.
T. (*T.*) *bataviana* (André). ♂.
T. (*T.*) *cameroni* (Schulz). ♀.
T. (*T.*) *iphis* Mickel. ♂.
T. (*T.*) *javanica* (Dalle Torre). ♂.
T. (*T.*) *melmora* (Cameron). ♀.

T. (*T.*) *nallinia* (Zavattari). ♂.
T. (*T.*) *nereis* (Kohl). ♀.
T. (*T.*) *philippinensis sunda* Mickel. ♂.
Smicromyrme herophile Mickel. ♂.
S. jacobsoni (André). ♂.

SUMBAWA.

Timulla (*Trogaspidia*) *dohertyi* (Zavattari). ♀.
T. (*T.*) *haemarrhoa* (Zavattari). ♂.
T. (*T.*) *serafica* (Zavattari). ♀.
Ephutomorpha sumbawae (Zavattari). ♀.

CELEBES.

Squamulotilla deserta (Smith). ♀.
S. facilis (Smith). ♂.
S. saffica (Zavattari). ♀.
Odontomutilla semifasciata (André). ♂.
O. smithi Mickel. ♀.
Timulla (*Trogaspidia*) *boniensis* Mickel. ♂.
T. (*T.*) *bonthainensis* (André). ♂.
T. (*T.*) *boopis* (Kohl). ♀.
T. (*T.*) *celebensis* (André). ♂ and ♀.
T. (*T.*) *fervida* (Smith). ♂ and ♀.
T. (*T.*) *implicata* Mickel. ♀.
T. (*T.*) *indagatrix menadoensis* Mickel. ♂.
T. (*T.*) *macassarica* (Zavattari). ♀.
T. (*T.*) *neglecta* (Smith). ♂.
T. (*T.*) *thoracica* (Smith). ♂.
T. (*T.*) *volatilis* (Smith). ♂.
Smicromyrme electra Mickel. ♂.
S. minahassae (Zavattari). ♂.

MORTY ISLAND.

Smicromyrme fluctuata (Smith). ♂.

GILOLO.

Odontomutilla simplicifascia (Sichel and Radoskowski). ♂ and ♀.

BACHIAN.

Odontomutilla apiastra Mickel. ♂.
Timulla (*Trogaspidia*) *anthylla* (Smith). ♂.
T. (*T.*) *ianthea ianthea* (Smith). ♂ and ♀.
T. (*T.*) *merops* (Smith). ♀.
T. (*T.*) *pentheus* (Smith). ♀.
Smicromyrme zebina (Smith). ♂ and ♀.

AMBOINA.

Timulla (*Trogaspidia*) *ianthea rubiginosa* (André). ♂ and ♀.
T. (*T.*) *indagatrix indagatrix* Mickel. ♂.
T. (*T.*) *oceanitis* Mickel. ♀.
T. (*T.*) *tethys melanesia* Mickel. ♂.
T. (*T.*) *vicina vicina* (Sichel and Radoskowski). ♀.
Ephutomorpha curta (André). ♀.

CERAM.

Odontomutilla ceramensis Mickel. ♂.
Timulla (*Trogaspidia*) *ianthea rubiginosa* (André). ♂ and ♀.
Ephutomorpha curta (André). ♀.
E. damia (Smith). ♂.
E. thera (Smith). ♀.

LARAT.

Timulla (*Trogaspidia*) *vicina laratensis* Mickel. ♀.

KEI.

Timulla (*Trogaspidia*) *exilis* (Smith). ♂.

ARU.

Odontomutilla manifesta (Smith). ♂ and ♀.
Timulla (*Trogaspidia*) *wallacei wallacei* (Cockerell). ♂.
Ephutomorpha carinata (Smith). ♂ and ♀.

MYSOL.

Ephutomorpha fausta (Smith). ♀.

WAIGIOU.

Ephutomorpha mirabilis (Smith). ♂.

NEW GUINEA.

Odontomutilla inanis Mickel. ♂ and ♀.
O. manifesta (Smith). ♂ and ♀.
O. tamensis (Cameron). ♀.
Timulla (*Trogaspidia*) *albertisi* (André). ♀.
T. (*T.*) *doricha* (Smith). ♀.
T. (*T.*) *oceanica* (André). ♂ and ♀.
T. (*T.*) *wallacei lalokia* Mickel. ♂.
T. (*T.*) *wallacei wallacei* (Cockerell). ♂ and ♀.
Ephutomorpha aerata (André). ♀.
E. agilis (Smith). ♂.
E. azurea (Mantero). ♂.
E. biröi André. ♀.
E. extranea (André). ♀.
E. fulgida (André). ♂ and ♀.
E. incisa André. ♀.
E. inclyta (André). ♀.
E. manteroi Zavattari. ♂.
E. mirabilis (Smith). ♂.
E. novo-guineana Zavattari. ♂.

E. pallidipes (André). ♂.
E. paradisiaca Zavattari. ♀.
E. praestans André. ♀.
E. splendida (Smith). ♂.

New Britain.

Timulla (*Trogaspidia*) *novobrittanica* (Cameron). ♂.

Solomon Islands.

Timulla (*Trogaspidia*) *oceanica tulagiensis* Mickel. ♂ and ♀.
Ephutomorpha pagdeni Mickel. ♂ and ♀.

New Caledonia.

Ephutomorpha caledonia (André). ♀.

Bibliography.

André, E., 1895, Mutillides d'Australie nouveaux ou imparfaitement connus. *Mém. Soc. zool. Fr.*, **8** : 475–517.

——, 1896*a*, Mutillides nouveaux ou imparfaitement connus faisant partie des collections du Musée National de Hongrie. *Termés. Füzetek*, **19** : 9–25.

——, 1896*b*, Étude sur les Mutillides existant dans les collections du Musée Civique de Gênes. *Ann. Mus. civ. Stor. nat. Genova*, (2) **17** : 66–104.

——, 1898, Étude sur les Mutillides du Muséum de Paris. *Ann. Soc. ent. Fr.*, **67** : 1 79.

——, 1899, Les types des Mutillides de la collection O. Radoskowski. *Ann. Soc. ent. Fr.*, **68** : 1–43.

——, 1899–1903, *Species des Hyménoptères d'Europe et d'Algerie*, **8** : 1–475, 15 pl.

——, 1903, Mutillidae. *Genera Insect.*, **11** : 1–77.

——, 1905, Mutillides nouveaux ou peu connus de l'Ancien Monde et de l'Australie. *Z. Hymen. Dipt.*, **5** : 201–216, 265-277.

——, 1907, Description d'une nouvelle espèce de Mutillide de Java. *Z. Hymen. Dipt.*, **7** : 207–208.

——, 1908, Description de quelques nouveaux Mutillides du Musée National de Hongrie. *Ann. Hist. nat. Mus. Hung.*, **6** : 375–383.

——, 1909, Mutillides nouveaux ou imparfaitement connus du Musée royal d'histoire naturelle de Leide. *Notes Leyden Mus.*, **31** : 171–180.

Ashmead, W. H., 1904, Descriptions of New Genera and Species of Hymenoptera from the Philippine Islands. *Proc. U.S. Nat. Mus.*, **28** : 135.

——, 1905, Additions to the Recorded Hymenopterous Fauna of the Philippine Islands, with Descriptions of New Species. *Proc. U.S. Nat. Mus.*, **28** : 962–963.

Bingham, C. T., 1895, On a Collection of Hymenopterous Insects from the Philippines. *Ann. Mag. nat. Hist.*, (6) **16** : 440–441.

Brown, Robert E., 1906, A Catalogue of Philippine Hymenoptera, with descriptions of New Species. *Philipp. J. Sci.*, **1** : 685, 689.

Cameron, P., 1900, Hymenoptera Orientalis, or Contributions to the knowledge of the Hymenoptera of the Oriental Zoological Region. Pt. 9. The Hymenoptera of the Khasia Hills. Pt. 2, sec. 1. *Mem. Manchester lit. phil. Soc.*, **44** (15) : 1–77.

——, 1901*a*, On the Hymenoptera collected in New Britain by Dr. Arthur Willey. *Proc. zool. Soc. Lond.*, **1901** (1) : 235–236.

——, 1901*b*, On the Hymenoptera collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900. *Proc. zool. Soc. Lond.*, **1901** (2) : 16–18.

——, 1902*a*, On the Hymenoptera collected by Mr. Robert Shelford at Sarawak, and on the Hymenoptera of the Sarawak Museum. *J. Straits Br. R. Asiat. Soc.*, **37** : 73–81.

——, 1902*b*, Description of New Species of Aculeate Hymenoptera from Borneo. *J. Straits Br. R. Asiat. Soc.*, **37** : 139–140.

——, 1902*c*, On some new genera and species of Hymenoptera. *Entomologist*, **35** : 207–208.

——, 1903, Descriptions of New Genera and Species of Hymenoptera taken by Mr. Robert Shelford at Sarawak, Borneo. *J. Straits Br. R. Asiat. Soc.*, **39** : 152–154.

Cameron, P., 1905, On the Malay Fossorial Hymenoptera and Vespidae of the Museum of the R. Zool. Soc. "Natura Artis Magistra" at Amsterdam. *Tijdschr. v. Ent.*, **48** : 48–52.

——, 1906, Hyménoptères *in Rés. Expéd. Sci. néerland. nouvelle-Guinée en* 1903, **5** (1) : 50.

——, 1909, Descriptions of Two New Species of *Mutilla* from Kuching, Borneo. *Entomologist*, **42** : 146–147.

Cockerell, T. D. A., 1907, Notes on the Nomenclature of some Hymenoptera. *Entomologist*, **40** : 50.

Cockerell, T. D. A., 1927, Hymenoptera from Lucban, Philippine Islands. *Philipp. J. Sci.*, **33** : 275–277.

Dalle Torre, C. G. von, 1897, *Catalogus Hymenopterorum hucusque descriptorum systematicus et synonymicus*, **8** : 1–99.

Esaki, T., et al., 1932, *Iconographia Insectorum Japonicorum* : 325–327.

Kohl, F. F., 1882, Neue Hymenopteren in den Sammlungen des k. k. zoolog. Hof-Cabinetes zu Wien. *Verh. zool.-bot. Ges. Wien*, **32** : 475–496.

Lepeletier de Saint-Fargeau, A. L. M., 1845, *Histoire Naturelle des Insectes. Hyménoptères*, **1** : 14; **3** : 517, 589–646.

Lopez, A. W., 1931, Report of Entomologist. *Ann. Rept. Res. Dept., Philipp. Sugar Ass.*, **1930–31** : 246–247.

Magretti, P., 1892, Viaggio di Leonardo Fea in Birmania e regioni vicine. Imenotteri. Pte. prima. *Ann. Mus. civ. Stor. nat. Genova*, (2) **12** : 203–234.

Mantero, G., 1900, Viaggio di Lamberto Loria nella Papuasia orientale, vol. 25. Mutillidae e Scoliidae. *Ann. Mus. civ. Stor. nat. Genova*, **40** : 580–587.

Matsumura, S., 1911, *1000 Insects of Japan, Suppl.*, **3** : 140, pl. 41, fig. 14.

——, 1930, *The Illustrated 1000 Insects of Japan. Hymenoptera*, **2** : 6 (English text) : 38 (Japanese text), pl. 41, fig. 14.

——, 1931, *6000 Illustrated Insects of Japan Empire* : 29.

——, 1932, *Illustrated Common Insects of Japan*, **4** : 11 (English text) : 8 (Japanese text), pl. 2, figs. 20 and 21.

Mickel, C. E., 1933*a*, A New Name for *Mutilla dimidiata* Lepeletier, with a redescription of the type specimen. *Ann. ent. Soc. Amer.*, **26** : 377–380.

——, 1933*b*, The Mutillidae of Formosa. *Ann. ent. Soc. Amer.*, **26** : 381–423.

——, 1933*c*, A New Species and Subspecies of Mutillidae from the Orient. *Lingnan Sci. J.*, **12** : 283–288.

——, 1933*d*, The Mutillidae of Eastern Asia. *Lingnan Sci. J.*, **12** : 289–325.

——, 1934, The Mutillidae of the Philippine Islands. *Philipp. J. Sci.*, **54** (1) : 91–219, pl. 1, figs. 1–10.

Pagden, H. T., 1934, New Species of Mutillidae (Hymenoptera, Vespoidea) from the Malay Peninsula. *J. F.M.S. Mus.*, **17** : 419–457, figs. 1–21.

Radoskowski, O., 1885, Revision des armures copulatrices des males de la famille de Mutillides. *Horae Soc. ent. ross.*, **19** : 3–47.

Rohwer, S. A., 1910, Some New Hymenopterous Insects from the Philippine Islands. *Proc. U.S. Nat. Mus.*, **37** : 658.

Saussure, H. de, 1867, *Reise der Novara*, (*Zool.*), **2** : 106–108.

Schulz, W. A., 1906, *Spolia Hymenopterologica.* Paderborn : 156–159.

Sichel, J., and Radoskowski, O., 1869, Essai d'une Monographie des Mutilles de l'Ancien Continent. *Horae Soc. ent. ross.*, **6** : 139–309.

Smith, Frederick, 1855, *Catalogue of Hymenopterous Insects in the Collection of the British Museum, Mutillidae and Pompilidae*, **3** : 1–63.

——, 1858, Catalogue of the Hymenopterous Insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. *J. Proc. linn. Soc., Zool.*, **2** : 83–87.

——, 1859*a*, Catalogue of Hymenopterous Insects collected at Celebes by Mr. A. R. Wallace. *J. Proc. linn. Soc., Zool.*, **3** : 9.

SMITH, FREDERICK, 1859*b*, Catalogue of Hymenopterous Insects collected by A. R. Wallace at the Islands of Aru and Kei. *J. Proc. linn. Soc., Zool.*, **3** : 150–151.

——, 1861*a*, Descriptions of New Species of Hymenopterous Insects collected by Mr. A. R. Wallace at Celebes. *J. Proc. linn. Soc., Zool.*, **5** : 75–77.

——, 1861*b*, Catalogue of Hymenopterous Insects collected by Mr. A. R. Wallace in the Islands of Bachian, Kaisaa, Amboyna, Gilolo, and at Dory in New Guinea. *J. Proc. linn. Soc., Zool.*, **5** : 114–116.

——, 1862, Catalogue of Hymenopterous Insects collected by Mr. A. R. Wallace in the Islands of Ceram, Celebes, Ternate, and Gilolo. *J. Proc. linn. Soc., Zool.*, **6** : 50.

——, 1864*a*, Notes on the Geographical Distribution of the Aculeate Hymenoptera collected by Mr. A. R. Wallace in the Eastern Archipelago. *J. Proc. linn. Soc., Zool.*, **7** : 110.

——, 1864*b*, Catalogue of Hymenopterous Insects collected by Mr. A. R. Wallace in the Islands of Mysol, Ceram, Waigiou, Bouru and Timor. *J. Proc. linn. Soc., Zool.*, **7** : 24–25.

——, 1865, Descriptions of New Species of Hymenopterous Insects from the Islands of Sumatra, Sula, Gilolo, Salwatty, and New Guinea, collected by Mr. A. R. Wallace. *J. Proc. linn. Soc., Zool.*, **8** : 79–80.

——, 1873*a*, A Catalogue of the Aculeate Hymenoptera and Ichneumonidae of India and the Eastern Archipelago. *J. Proc. linn. Soc., Zool.*, **11** : 285–302, 336–341.

——, 1873*b*, Descriptions of Aculeate Hymenoptera of Japan, collected by Mr. George Lewis at Nagasaki and Hiogo. *Trans. ent. Soc. Lond.*, **1873** : 182–183.

——, 1874, Descriptions of New Species of Tenthredinidae, Ichneumonidae, Chrysididae, Formicidae, etc. of Japan. *Trans. ent. Soc. Lond.*, **1874** : 407–408.

——, 1879, *Descriptions of New Species of Hymenoptera in the Collection of the British Museum* : 189–227.

WALLACE, A. R., 1873, A Catalogue of Aculeate Hymenoptera and Ichneumonidae of India and the Eastern Archipelago. *J. Proc. linn. Soc., Zool.*, **11** : 285–302.

WESTWOOD, J. O., 1843, *Arcana Entomologica, or New, Rare, and Interesting Insects.* (Mutillidae of New Holland), **2** : 17–19.

WILLIAMS, F. X., 1919, Philippine Wasp Studies: Pt. 2, Descriptions of New Species and Life History Studies. *Bull. Hawaii. Sugar Plant. Exp. Stat.*, (*Ent.*) **14** : 63–64.

ZAVATTARI, E., 1910, Catalogo delle Mutille del Museo Zoologico di Napoli. *Ann. Mus. zool. Univ. Napoli,* (n.s.) **3** (9) : 1–16.

——, 1913*a*, H. Sauter's Formosa-Ausbeute. Mutillidae. *Arch. f. Naturges.*, **79** A. (3) : 19–42.

——, 1913*b*, Mutille Austro-malesi. *Boll. Soc. ent. ital.*, **45** : 61–114.

INDEX.

A

aerata, Ephutomorpha.
aesyca, Squamulotilla.
agilis, Ephutomorpha.
alberica, Smicromyrme.
albertisi, Timulla.
amans, Timulla.
amartana, Timulla philippinensis.
analis, Timulla.
andromeda, Odontomutilla.
annexa, Smicromyrme.
annularis, Smicromyrme.
anonyma, Odontomutilla familiaris.
anthracipes, Smicromyrme fura.
anthylla, Timulla.
apiastra, Odontomutilla.
ardescens, Squamulotilla.
arundinacea, Squamulotilla.
aspratilis, Odontomutilla.
atrata, Smicromyrme lavinia.
aurifera, Timulla ovatula.
autonoe, Smicromyrme.
azurea, Ephutomorpha.

B

bagrada, Timulla.
bakeri, Smicromyrme ; Timulla.
basalis, Smicromyrme.
bataviana, Timulla.
birói, Ephutomorpha.
boniensis, Timulla.
bonthainensis, Timulla.
boopis, Timulla.
byblis, Squamulotilla.

C

caecina, Smicromyrme.
caerulea, Smicromyrme.
caledonica, Ephutomorpha.
calliope, Smicromyrme.
calliopeia, Squamulotilla.
cameroni, Timulla.
cardea, Squamulotilla.
carinata, Ephutomorpha.
carinulifera, Squamulotilla.
cassiope, Odontomutilla.
celebensis, Timulla.
ceramensis, Odontomutilla.
circumcincta, Timulla.
clypealis, Squamulotilla.
concava, Squamulotilla ; Timulla.
cooki, Timulla.
curta, Ephutomorpha.
cydippe, Timulla.
Cystomutilla teranishii **sp.n.**, 196.

D

damia, Ephutomorpha.
dardanus, Smicromyrme.
decora, Smicromyrme.
deidamia, Smicromyrme.
delia, Smicromyrme.
denotata, Timulla.
depressicornis, Timulla.
depressula, Timulla.
dercetis, Timulla.
deserta, Squamulotilla.
devia, Smicromyrme.
dictynna, Squamulotilla.
discolor, Timulla suspiciosa.
discrepans, Timulla friekae.
disjuncta, Squamulotilla.
disparilis, Timulla.
dohertyi, Timulla.
doricha, Timulla.
drola, Smicromyrme.
drupa, Smicromyrme.

E

electra, Smicromyrme.
elpinice, Timulla.
eminula, Squamulotilla.
Ephutomorpha, key to spp., 293–295.
    aerata, 299.
    agilis, 295.
    azurea, 295.
    birói, 296.
    caledonica, 296.
    carinata, 295.
    curta, 298.
    damia, 300.
    extranea, 298.
    fausta, 300.
    fulgida, 300.
    incisa, 296.
    inclyta, 300.
    manteroi, 300.
    mirabilis, 299.
    morosa, 301.
    novo-guineana, 301.
    pagdeni **sp.n.**, 296.
    pallidipes, 299.
    paradisiaca, 300.
    praestans, 296.
    splendida, 299.
    sumbawae, 298.
    thera, 298.
erato, Timulla.
erdae, Squamulotilla.
eremita, Timulla.
europaea, Mutilla.
exilis, Timulla.
extranea, Ephutomorpha.

F

facilis, Squamulotilla.
familiaris, Odontomutilla.
fausta, Ephutomorpha.
fervida, Timulla.
fluctuata, Smicromyrme.
formosana, Squamulotilla ; Timulla.
fortuita, Timulla.
friekae, Timulla.
fucosa, Squamulotilla.
fulgida, Ephutomorpha.
fura, Smicromyrme.

G

galatea, Squamulotilla.
gracillima, Smicromyrme.
gribodoi, Timulla.
grossa, Odontomutilla.
guntheri, Smicromyrme.
gutrunae, Timulla.

H

haemarrhoa, Timulla.
haematocephala, Odontomutilla.
hageni, Smicromyrme.
herophile, Smicromyrme.
herpa, Odontomutilla.
hoozana, Myrmilla.
hyale, Smicromyrme.
hylonome, Timulla.

I

ianthea, Timulla.
ilerda, Smicromyrme.
imparilis, Squamulotilla.
implicata, Timulla.
inanis, Odontomutilla.
incisa, Ephutomorpha.
inclyta, Ephutomorpha.
insidiator, Timulla.
iphis, Timulla.
ira, Timulla.
islandica, Timulla minor.
itambusa, Timulla philippinensis.

J

jacobsoni, Smicromyrme.
javanica, Timulla.

K

kedahensis, Smicromyrme.
kellyi, Timulla.
krianae, Timulla tethys.

L

lalokia, Timulla wallacei.
laratensis, Timulla vicina.
lavinia, Smicromyrme.
lewisi, Smicromyrme.
lodina, Timulla.
logei, Timulla.
luzonica, Timulla.

M

macassarica, Timulla.
maculofasciata, Timulla.
malayana, Timulla philippinensis.
malica, Squamulotilla.
mamblia, Timulla.
manifesta, Odontomutilla.
manilensis, Timulla.
manteroi, Ephutomorpha.
meator, Smicromyrme.
melanesia, Timulla tethys.
melmora, Timulla.
menadoensis, Timulla indagatrix.
merops, Timulla.
mikado, Mutilla europaea.
minae, Timulla.
minahassae, Smicromyrme.
minor, Timulla.
mirabilis, Ephutomorpha.
morosa, Ephutomorpha.
muiri, Squamulotilla.
multidentata, Squamulotilla.
Mutilla europaea mikado, 199.
Myrmilla hoozana, 183.

N

naja, Smicromyrme.
nallinia, Timulla.
neaera, Smicromyrme.
nebulosa, Timulla fortuita.
nedyme, Timulla.
neglecta, Timulla.
nereis, Timulla.
nigerrima, Timulla.
nigricula, Smicromyrme lewisi.
nigridia, Timulla.
nigrogastra, Smicromyrme semperi.
nipponica, Timulla taihorina.
nitela, Smicromyrme.
norna, Smicromyrme.
novo-guineana, Ephutomorpha.

O

oblectabilis, Squamulotilla.
oceanica, Rhopalomutilla ; Timulla.
oceanitis, Timulla.
ocypote, Squamulotilla.
Odontomutilla, key to spp., 199–201.
  andromeda, 216.
  apiastra **nom.n.**, 208.
  aspratilis **sp.n.**, 210.
  cassiope, 216.
  ceramensis **sp.n.**, 206.
  familiaris anonyma, 202.
  familiaris familiaris, 201.
  grossa **sp.n.**, 214.
  haematocephala, 213.
  herpa, 208.
  inanis **sp.n.**, 204.
  manifesta, 207.
  pedaria, 216.
  pompalis **sp.n.**, 212.
  rubrocapitata **sp.n.**, 208.
  semifasciata, 204.
  simplifasciata, 204.
  smithi **sp.n.**, 202.
  subinterrupta, 217.
  taiwaniana, 216.
  tamensis, 208.
  thymele **sp.n.**, 211.
  unimaculata, 203.
  urania, 213.
olbia, Timulla.
opipara, Squamulotilla.
orientalis, Timulla.
oryzae, Timulla.
ovatula, Timulla.

P

pagdeni, Ephutomorpha ; Timulla.
palaca, Squamulotilla.
palawana, Timulla ira.
palawanensis, Smicromyrme.
pallidipes, Ephutomorpha.
panayensis, Timulla luzonica.
paradisiaca, Ephutomorpha.
parva, Smicromyrme.
pedaria, Odontomutilla.
pendleburyi, Timulla.
pentheus, Timulla.
perakensis, Squamulotilla.
pfafneri, Timulla.
philippinensis, Timulla.
pompalis, Odontomutilla.
praestans, Ephutomorpha.
princesa, Timulla minor.
prodiga, Timulla tethys.
proserpina, Timulla.
psecas, Timulla.
punctinota, Smicromyrme.
pustulata, Timulla.

R

rapa, Timulla.
repraesentans, Timulla.
repraesentoides, Timulla.
rhea, Timulla.
Rhopalomutilla oceanica **sp.n.,** 197.
roxane, Squamulotilla.
rubiginosa, Timulla ianthea.
rubricapitata, Odontomutilla.
rubrocyanea, Timulla.
runcina, Smicromyrme.

S

saffica, Squamulotilla.
salacia, Squamulotilla dardanus.
samawangensis, Timulla saturnia.
sandakensis, Timulla minor.
sarawaka, Timulla.
saturnia, Timulla.
sauteri, Squamulotilla.
scitula, Smicromyrme.
selangorensis, Squamulotilla.
semifasciata, Odontomutilla.
semperi, Smicromyrme.
serafica, Timulla.
serpa, Smicromyrme.
shelfordi, Timulla.
sibuyanensis, Timulla proserpina.
sibylla, Timulla.
singapora, Timulla philippinensis.
skeati, Timulla.
Smicromyrme, key to spp., 271–275.
  alberici, 293.
  annexa, 284.
  autonoe, 293.
  bakeri, 291.
  basalis annularis, 290.
  basalis basalis, 290.
  caecina, 285.
  caerulea, 284.
  calliope, 284.
  dardanus dardanus, 282.
Smicromyrme dardanus salacia **subsp.n.,** 282.
  decora, 288.
  deidamia, 292.
  delia **sp.n.,** 282.
  devia, 284.
  drola, 282.
  drupa, 288.
  electra **sp.n.,** 280.
  fluctuata, 292.
  fura anthracipes, 288.
  fura fura, 288.
  gracillima, 275.
  guntheri, 287.
  hageni, 291.
  herophile **sp.n.,** 275.
  hyale, 278.
  ilerda ilerda, 278.
  ilerda sparsilis, 278.
  jacobsoni, 284.
  kedahensis **nom.n.,** 290.
  lavinia atrata, 287.
  lavinia lavinia, 287.
  lewisi lewisi **nom.n.,** 288.
  lewisi nigricula **subsp.n.,** 289.
  lewisi yanoi **nom.n.,** 289.
  meator **sp.n.,** 285.
  minahassae, 276.
  naja, 275.
  neaera **sp.n.,** 278.
  norna, 288.
  palawanensis, 292.
  parva, 290.
  punctinota **sp.n.,** 286.
  runcina, 279.
  scitula **sp.n.,** 279.
  semperi nigrogastra, 291.
  semperi semperi, 291.
  serpa, 275.
  strandi, 275.
  thalia, 283.
  thia, 291.
  triguttata, 293.
  viriata nitela, 285.
  viriata viriata, 284.
  volupia **sp.n.,** 277.
  wotani, 291
  zavattarii **sp.n.,** 282.
  zebina, 292.
smithi, Odontomutilla.
sparsilis, Smicromyrme ilerda.
spatale, Timulla.
splendida, Ephutomorpha.
Squamulotilla, key to spp., 183–186.
  aesyca, 194.
  ardescens, 194.
  arundinacea, 196.
  byblis, 190.
  calliopeia **sp.n.,** 188.
  cardea **sp.n.,** 192.
  carinulifera, 195.
  clypealis **sp.n.,** 189.
  concava, 188.
  deserta, 193.
  dictynna, 187.
  disjuncta, 187.
  eminula, 190.
  erdae, 195.
  facilis, 186.
  formosana, 188.
  fucosa, 195.

Squamulotilla galatea, 193.
imparilis, 187.
malica, 193.
muiri **sp.n.**, 186.
multidentata, 193.
oblectabilis, 195.
ocypote, 187.
opipara, 193.
palaca, 188.
perakensis, 196.
roxane, 188.
saffica, 193.
sauteri, 195.
selangorensis, 196.
subdebilis, 188.
subtriangularis, 190.
sulpicilla, 188.
teuta teuta, 189.
teuta vicinaria, 189.
trituberculata, 195.
tumidula, 187.
umbrosa, 190.
venatrix **sp.n.**, 190.
stella, Timulla.
sticticornis, Timulla.
strandi, Smicromyrme.
subdebilis, Squamulotilla.
subinterrupta, Odontomutilla.
subintrans, Timulla.
subtriangularis, Squamulotilla.
sulpicilla, Squamulotilla.
sumatrensis, Timulla.
sumbawae, Ephutomorpha.
sunda, Timulla philippinensis.
suspiciosa, Timulla.

T

taihorina, Timulla.
taiwanensis, Timulla orientalis.
taiwaniana, Odontomutilla.
tamensis, Odontomutilla.
tayabasensis, Timulla minor.
tegularis, Timulla.
temeraria, Timulla.
teranishii, Cystomutilla.
tethys, Timulla.
teuta, Squamulotilla.
thalia, Smicromyrme.
thera, Ephutomorpha.
thia, Smicromyrme.
thoracica, Timulla.
thymele, Odontomutilla.
tibiata, Timulla proserpina.
Timulla (*Trogaspidea*), key to spp., 218–228.
albertisi, 231.
amans, 236.
analis, 235.
anthylla, 239.
bagrada, 263.
bakeri, 247.
bataviana, 250.
boniensis **sp.n.**, 242.
bonthainensis, 257.
boopis, 269.
cameroni, 253.
celebensis, 266.
circumcincta, 267.
concava, 239.
Timulla cooki, 271.
cydippe **sp.n.**, 239.
denotata, 239.
depressicornis **sp.n.**, 264.
depressula, 247.
dercetis **sp.n.**, 261.
disparilis, 234.
dohertyi, 267.
doricha, 231.
elpinice, 250.
erato **sp.n.**, 241.
eremita eremita, 246.
eremita umbra, 246.
exilis, 230.
fervida, 246.
formosana, 270.
fortuita fortuita, 263.
fortuita nebulosa **subsp.n.**, 263.
friekae discrepans, 266.
friekae friekae, 266.
gribodoi, 270.
gutrunae, 265.
haemarrhoa, 248.
hylonome **sp.n.**, 258.
ianthea ianthea, 247.
ianthea rubiginosa, 248.
implicata **sp.n.**, 238.
indagatrix **sp.n.**, 237.
indagatrix menadoensis **subsp.n.**, 238.
insidiator, 255.
iphis **sp.n.**, 234.
ira ira, 265.
ira palawana, 265.
javanica, 270.
kellyi, 267.
lodina, 252.
logei, 267.
luzonica luzonica, 246.
luzonica panayensis, 247.
macassarica, 255.
maculofasciata, 270.
mamblia, 268.
manilensis, 252.
melmora, 254.
merops, 250.
minae, 247.
minor islandica, 233.
minor minor, 232.
minor princesa, 233.
minor sandakensis **subsp.n.**, 233.
minor tayabasensis, 233.
minor visayensis, 233.
minor whiteheadi, 233.
nallinia, 263.
nedyme **sp.n.**, 259.
neglecta, 265.
nereis, 252.
nigerrima, 265.
oceanica oceanica, 231.
oceanica tulagiensis **subsp.n.**, 232.
oceanitis **sp.n.**, 253.
olbia, 261.
orientalis orientalis, 266.
orientalis taiwanensis, 266.
oryzae, 236.
ovatula aurifera, 247.
ovatula ovatula, 247.
pagdeni pagdeni, 246.
pendleburyi, 244.
pentheus, 254.

Timulla pfafneri, 267.
  philippinensis amartana, 229.
  philippinensis itambusa, 229.
  philippinensis malayana, 230.
  philippinensis philippinensis, 228.
  philippinensis singapora **subsp.n.**, 229.
  philippinensis sunda **subsp.n.**, 229.
  philippinensis williamsi, 229.
  proserpina proserpina, 269.
  proserpina sibuyanensis, 269.
  psecas **sp.n.**, 268.
  pustulata, 248.
  rapa, 257.
  repraesentans, 254.
  repraesentoides, 254.
  rhea, 243.
  rubrocyanea **sp.n.**, 256.
  sarawaka **sp.n.**, 249.
  saturnia samawangensis **subsp.n.**, 256.
  saturnia saturnia **nom.n.**, 256.
  serafica, 251.
  shelfordi **sp.n.**, 244.
  sibylla, 244.
  skeati, 230.
  spatale **sp.n.**, 260.
  stella, 258.
  sticticornis nigridia, 262.
  sticticornis sticticornis, 262.
  subintrans, 270.
  sumatrensis, 259.
  suspiciosa discolor, 244.
  suspiciosa suspiciosa, 243.
  taihorina nipponica **subsp.n.**, 254.
  taihorina taihorina, 254.
  tegularia, 248.
  temeraria, 263.
  tethys krianae, 249.
  tethys melanesia **subsp.n.**, 249.
  tethys prodiga **subsp.n.**, 249.
  tethys tethys, 249.
  thoracica, 255.
  tibiata, 269.
  vicina laratensis **subsp.n.**, 252.
  vicina vicina, 251.
Timulla volatilis, 266.
  wallacei lalokia **subsp.n.**, 231.
  wallacei wallacei, 231.
triguttata, Smicromyrme.
trituberculata, Squamulotilla.
Trogaspidia (see *Timulla*).
tulagiensis, Timulla oceanica.
tumidula, Squamulotilla.

U

umbra, Timulla eremita.
umbrosa, Squamulotilla.
unimaculata, Odontomutilla.
urania, Odontomutilla.

V

venatrix, Squamulotilla.
vicina, Timulla.
vicinaria, Squamulotilla teuta.
viriata, Smicromyrme.
visayensis, Timulla minor.
volatilis, Timulla.
volupia, Smicromyrme.

W

wallacei, Timulla.
whiteheadi, Timulla minor.
williamsi, Timulla.
wotani, Smicromyrme.

Y

yanoi, Smicromyrme lewisi.

Z

zavattarii, Smicromyrme.
zebina, Smicromyrme.

THE RHOPALOCERA OF ABYSSINIA
A FAUNISTIC STUDY

By G. D. Hale Carpenter, M.B.E., D.M., F.L.S., F.Z.S.

(Hope Professor of Zoology (Entomology) in the University of Oxford.)

WITH NOTES ON PARTICULAR POINTS by W. H. Evans, C.S.I., C.I.E., D.S.O., Francis Hemming, C.B.E., G. Talbot, and E. J. Wayland.

[Read 2nd October, 1935.]

With plates VIII to XII and one map.

Contents.

PAGE
Section I. Introductory and acknowledgments 313
,, II. Geographical data 316
,, III. Species and forms known from Abyssinia, as defined in Section II 319
,, IV. Zoogeographical affinities of the species known from Abyssinia 411
,, V. Altitudes to which certain species are confined in Abyssinia . 418
,, VI. Brief notes on other Abyssinian invertebrates . . . 422
,, VII. Conclusions 426
,, VIII. List of papers referred to 430
List of new names proposed in the present paper . . . 434
Appendix 1. Note on the genotypes of three genera of Rhopalocera represented in the fauna of Abyssinia by Francis Hemming, C.B.E. 435
,, 2. Note on climatic and topographic changes in relation to biological distribution by E. J. Wayland 436

Section I. Introductory and acknowledgments.

This paper is an attempt to bring together all the published records of Abyssinian Rhopalocera and is the result of examination of specimens in the Hope Department of Entomology in the Oxford University Museum, the Museum at Tring, and in the National Collection at the British Museum (Natural History). It has arisen from the working out of a very fine collection from south-west Abyssinia made by Sir Arnold W. Hodson, K.C.M.G., during 1925–27, when he was serving in Abyssinia as H.M. Consul. He very generously sent all the specimens to the Hope Department, and the collection, now permanently arranged and kept as an entity, comprises some 3000 specimens belonging to about 260 species.

I commenced work on this series in 1933 and solicited the help of the late Dr. F. A. Dixey, F.R.S., with the Pieridae, and he kindly identified and arranged the species: for the further identification of forms I am responsible, but Mr. G. Talbot, F.R.E.S., very kindly gave his authoritative opinion in cases of difficulty. He also helped with the Lycaenidae, and new species or forms have been described by him (1935). The identification of the Hesperiidae depended largely upon Brigadier W. H. Evans, C.S.I., C.I.E., D.S.O., who was then reviewing African species, and he most kindly named the less obvious specimens.

The Hodson collection being so large there seemed to be a good opportunity for reviewing the whole subject of Abyssinian Rhopalocera, more especially as Monsieur H. Ungemach had just published (1932) a fine account of a large collection made by him which in many respects was complementary to Hodson's. Permission was obtained from the Keeper of Entomology, to whom I am greatly indebted, to work out a collection brought to the British Museum (Natural History) by Dr. Hugh Scott from the 1926–27 expedition, and a small collection presented to the Hope Department by Mr. G. H. Bullock was also examined.

In order that unrecorded specimens should not be overlooked I sought the assistance of the Keeper of Entomology at the British Museum (Natural History), and of Lord Rothschild, F.R.S., who most kindly arranged that search should be made for specimens of species which might be expected in Abyssinia but of which no records existed. This entailed considerable expenditure of time and energy on the part of Mr. A. G. Gabriel and Mr. F. W. Goodson, to whom I am very greatly indebted. To the former I have continually appealed for help in various ways and always met with a ready response. Mr. N. D. Riley has given much help in the identification of SATYRIDAE and LYCAENIDAE. Thanks are also due to the following gentlemen who in one way or another have given kind help with specimens or in the preparation of this paper:—Mr. J. N. L. Baker, B.Litt., who kindly lent maps from the School of Geography; Dr. C. Le Doux; Lieut.-Col. R. E. Drake Brockman, D.S.O., M.D.; Dr. H. Eltringham, F.R.S.; Dr. R. Hanitsch; Professor Dr. Hering; Dr. B. M. Hobby; Dr. K. Jordan, F.R.S.; Mr. A. Levick; Major F. Moysey; Mr. J. Omer Cooper, M.A.; Captain I. G. Owen; Sir Edward Poulton, F.R.S.; Dr. K. S. Sandford; Dr. Hugh Scott; Dr. Embrik Strand; and Monsieur H. Ungemach. I am particularly indebted to the last named for his kindness in sending me doubtful specimens and finally for showing me his splendid collection and allowing me to correct some errors of identification.

Mr. Francis Hemming, C.B.E., and Mr. N. D. Riley have most kindly gone over the proofs and have revised the names used for the genera and species in accordance with the most recent work. In addition, Mr. Hemming has prepared a generic diagnosis for a group of species of NYMPHALIDAE which are at present without a valid generic name. An explanatory note in which Mr. Hemming sets out the reasons for this change and also the reasons for changes in the names of two genera, one belonging to the LYCAENIDAE, and the other to the HESPERIIDAE is given as Appendix 1 to this paper. Brigadier W. H. Evans has kindly prepared generic diagnoses for two species of HESPERIIDAE which are at present without valid generic names.

Special thanks are due to Mr. E. J. Wayland, Director of the Geological Survey of Uganda, for kindly writing a short account of his views on Pleistocene geological events in East Africa which are given as Appendix 2 to this paper. Dr. J. Burtt Davy, of the Imperial Forestry Institute, kindly gave up some of his time to allow me to discuss with him the distribution of forest trees in the areas considered in this paper.

The *Zoological Record* was searched systematically for references to Rhopalocera from Abyssinia, commencing with the year after the publication of " Rhopalocera Aethiopica " by Aurivillius in 1898, in which references were given to previous papers. The list of references at the end of the present paper embodies such as I found of which the most important are those by Pagenstecher (1902), Rothschild and Jordan (1903), Le Cerf (1924c) and Ungemach (1932). The latter gives an extremely interesting general account of the terrain and types of fauna in the different areas through which he travelled in southern Abyssinia from east to west : I had hoped to quote from it extensively as it is published in a somewhat inaccessible journal, but I found that the account of the species became so long that descriptions of the country had to be omitted. Pagenstecher made some interesting general remarks on the country traversed by Erlanger, and maps of his route were published by Dietrich Reimer (Ernst Vohsen), Berlin (1904, *Z. Ges. Erdk.* **1904** : pls. 2–5). Neumann (1902), Donaldson Smith (1895) and Ungemach (1932) give maps of their routes.

An endeavour to compile a faunal list of " Abyssinia " meets with the immediate difficulty that within the political boundary there are very different types of country. Moreover, Eritrea, another political entity, should not be separated from " Abyssinia " in a faunistic study. Since early investigators have shown that the lowlands have little peculiarity I decided to take a contour line as the boundary of the area to be considered. The exact elevation was important, for by selecting too low a level one would include too many forms which have little to do with the really characteristic Abyssinian country, and by going too high one would exclude quite a number of forms only found within the Abyssinian border. Finally, the *contour line of 1500 metres* was selected to determine the area of " Abyssinia " to be considered. Some qualification is necessary in regard to the Hodson collection. This is such a fine collection that a complete account of it has been made, although some specimens come from outside the limit just mentioned, and a few even from the Sudan (*e.g.* Boma plateau). Reference to the full topographical data which he kindly supplied will show the recorded localities for each species (Section II). It has frequently been difficult to ascertain from older records whether they should be included here : thus, Butler (1876) described a collection from " Abyssinia " but gave the exact locality as Atbara ! The species and forms given by him have, however, been established as truly Abyssinian by later observers.

The map accompanying this paper shows the area included within the 1500 m. contour except for a small tongue running out to the east of Harar. It has been traced from maps by the Geographical Section, General Staff 2871, 1922 and 1931. On it have been indicated such journeys as have provided information of the Rhopalocerous fauna, and names of places from which smaller collections, or a few specimens, have been obtained. The localities given by Hodson appear in greater detail because one of the chief aims of this paper is to give an account of his collection, hitherto undescribed. The important accounts of the collections of Erlanger and Neumann, given by Pagenstecher (1902), and Rothschild and Jordan (1903, 1905), contain full data of the specimens. It will be seen that while our knowledge is quite good for the country to the south of 10° N. we know practically nothing about the area between that parallel and the frontier of Eritrea. There are a few records from Eritrea (Cannaviello, 1902; Le Cerf, 1924c), but many of the species mentioned therein were obtained near the sea.

Any effort to explain the peculiarities of the Abyssinian fauna must depend upon knowledge of the mountains of southern Sudan. In this respect the Hope Department is fortunate, for in 1926 I was able to obtain a considerable collection from the Didinga mountains (Carpenter, 1928 : see also Talbot, 1929b), the first collection made in that locality, and since then Captain I. G. Owen, of the Sudan Defence Force, has generously given many specimens collected by himself on the Imatong mountains and the Acholi hills on the Sudan–Uganda border, and many rarities from the little known border between the Sudan and the French territory. A fine collection from the Imatong mountains made by Captain A. L. Kent Lemon in 1919, and a most interesting series from the Nuba mountains by Lieut.-Col. R. S. Wilson, collected in 1904–05 and 1917–19

(Longstaff, 1916), were presented most generously to the Hope Department. Through the kindness of Major Moysey I was able to see a long list of his captures on the Imatong mountains, and by all these means it has been possible to put together some interesting data bearing on the Abyssinian problem. It will be obvious that an investigation of the great mountain mass Jebel Marra in Darfur would yield results of the highest interest.

I have appended to the discussion of the Rhopalocera brief summaries of work on other Abyssinian invertebrates, mainly from papers on the results of the Omer-Cooper–Scott expedition of 1926–27. The chief point on which information was sought, and with which this paper is chiefly concerned, is the east-west relationship. The whole question of the origin of the complex Abyssinian fauna is a larger subject which it is hoped will be discussed by another writer within the next few years when more material will be available. The present paper is intended to provide a step in the building of the edifice : so far as I am aware no complete catalogue of all Abyssinian members of any group of insects as large and well known as the Rhopalocera has yet been made, and I hope that this paper will aid and stimulate further inquiry into the presence and absence of species of animals in and from this most interesting region.

SECTION II. GEOGRAPHICAL DATA.

The Hodson collection was made in the extreme south-west corner of Abyssinia, overlapping a little into the adjoining Sudan : it was not entirely from within the 1500 metre contour. Nevertheless, for the sake of treating this large collection as a whole all records are included here, and the reader will see by the reference numbers the localities for each species. The following list was prepared according to the data supplied with the specimens and all places, the position of which was given, arranged in order from north to south between parallels 34°–35° E. and from south to north between 35°–36° E., in order to facilitate reference by numbers. Localities, the position of which was not signified, were placed according to date of visit; those which could not be fixed were written at the end.

Some time after this had been done, and the list of species made out, a map by Hodson[1] was found on which every place was marked and it appeared that my order in the list would require revising if absolute correctness of precedence was to be observed. For instance, 52, Kocha, should be very near 45, Meti Chafe : and 46, Gosh Kand, very near Manta Bacchi, 53. Amora Gadel Mt. must be a name that occurs in two areas, for the name on Hodson's map is in the Sudan at about 4° 40′ N. and 34° 40′ E., whereas the locality of the same name from which specimens came is stated by him to be at an altitude of 4500 ft. in Gimira Province at 7° 7′ N., 35° 30′ E.

The revision of all the reference numbers under the species which would be required to obtain the ideal sequence was not considered worth while. The spelling so far as possible is as in the War Office map : when Hodson's names differ they follow in brackets.

1. Abot (Agot) R. 8° 7′ N., 34° 36′ E., 1400 ft., 19.xi.25.
2. Fulo Vlei (Pulo is printed on the labels probably by mistake). 7° 58′, 34° 44′, 1400 ft., 18.xi.25.
3. Aluro (Aloru) R. 7° 55′, 34° 42′, 1400, 17.xi.25.
4. Apeni (Apeny on labels) R. 7° 50′, 34° 36′, 1700, 16.xi.25.
5. Got R. 7° 42′, 34° 63′, 1700, 15.xi.25.

---

[1] Maji area ; obtainable from the Director of Surveys, Khartoum.

6. Pakodi (Pokodi). 7° 38′, 34° 42′, 1700, 14.xi.25.
7. Jaro R. (very near Pakodi). 7° 35′, 34° 47′, 1800, 13.xi.25.
8. Kide's Village. 7° 34′, 34° 52′, 2000, 12.xi.25.
9. Yapo (Yape) Vlei. 7° 28′, 34° 52′, 1900, 11.xi.25.
10. Jale Mt., near Gilo R. 7° 24′, 34° 54′, 1700, 10.xi.25.
11. Gila (Gilo) R. 7° 22′–20′, 34° 55′–35° 1′, 6–9.xi.25.
12. Jinjibil R. 7° 20′, 35° 1′, 1700, 5.xi.25.
13. Leman R. 7° 12′, 35°, 2300, 2–3.xi.25.
14. Akula R. 7°–6° 56′, 35°–34° 48′, 31.x–2.xi.25.
15. Elephant Hill. 6° 6′, 34° 48′, 1900, 30.x.25.
16. Tinga-Tinga R. 6° 52′, 34° 48′, 1700, 29.x.25.
17. Akobo R. 6° 42′–36′, 34° 52′–48′, 1600–1650, 26–28.x.25 : 2500, 12.iii.25.
18. Meino R. 6° 42′–30′, 34° 45′–48′, 2000–2100, 23–25.x.25.
19. Boma Plateau. 6° 18′–10′, 34° 28′–41′, 2200–4000, 15–22.x.25.
20. Derak Wonz (very near Tirma, 21). 5° 57′, 35° 25′, 2600, 20–29.ix.25.
21. Tirma. 5° 55′, 35° 20′, 3900–4400, 30.xi.24, 25–26.iv.25, 30.ix.25.
22. Cherosh Wonz. 5° 48′, 35°–35° 15′, 3500, 1.x.25.
23. Kuron or Gosha Waha R. 5° 40′–48′, 34° 40′–35° 12′, 2100–3100, 2–14.x.25 : 3300–3500, 26–28.iv.25.
24. Siski Mt. (probably near 25). 6500, 5.ix.25.
25. Tamatiro (Tomadur). 3300, 29.iv.25, 2.ix.25.
26. Maji Province (without details). 31.xii.24, 15.ii.25 (7700 ft.), 10, 31.iii.25, 2, 5, 16.iv.25, 8.ix.25, 10, 15.ix.25 (7700 ft.), 20–21.ix.25.
27. Humo, Maji Province (near Chabera, 66). 15.i.25.
28. Bashuma (Berchuma). 17.i.25.
29. Kibish R. 6°–6° 1′, 35°–35° 28′, 4000, 16.iii.25 : 2600–2800, 23–24.iv.25, 28.ix.25.
30. Aduka's (Adika). 6° 4′, 35° 34′, 4500, 27.ix.25.
31. Wur R., Maji Province. 6000, 1924.
32. Shoa Gimira Province (without details). 24.ix.24 (6000 ft.), 18–25.i.25, 27–28.i.25, 1.ii.25.
33. Kibu, Gimira Province. 24.i.25.
34. Burtura, Shoa Gimira Province (near Kibu). 23.i.25.
35. Amarr (Aman on labels), Shoa Gimira Province. 25–27.i.25, 1.ii.25.
36. Tirka, Gimira district. 3200–4200, 26–28.ii.25.
37. Tamanjayage, Shoa Gimira Province. 28–29.i.25.
38. Badika (Bakida on labels). Very near Tamanjayage. 31.i.25.
39. Gura Farda range. 6° 50′, 35° 7′, 5700–6000, 7.iii.25, 3.ii.27, 18.ii.27.
40. Below Gura Farda. 3100, 10.iii.25.
41. Alanga R. 6° 54′, 35° 15′, 2700, 16.ii.27.
42. Gacheb (Gacher) R. 7° 1′–22′, 35°–35° 22′, 3800, 15.ii.27.
43. Koricha, Bako R. district. 7° 6′, 35° 27′, 3700, 25.ii.25, 10.ii.27.
44. Amora Gadel Mt., Gimira Province. 7° 7′, 35° 30′, 4500, 1.ii.25, 11.ii.27.
45. Meti (Mate) Chafe, Nado's Province. 7° 13′, 35° 22′, 4500–4600, 3–4.ii.25, 7.ii.27.
46. Gosh Kand (Kana on labels). Very near Manta Bacchi (53). 5.ii.25.
47. Gamachisa, Nado's Province. 6800, 6.ii.25.
48. Junction Mt. 7° 15′, 35° 3′, 1950, 4.xi.25.
49. Safara Faringhi, Mocha district. 7200–7300, 18.ii.25.
50. Gamadura, Mocha district. 6200, 22.ii.25.
51. Jeki (Yeki), Bako R. district. 4400, 15.ii.25, 23.ii.25. ; Nado's Province, 4900–4950, 3.ii.25.

52. Kocha (very near Meti Chafe, 45). 5500, 23.ii.25.
53. Manta Bacchi. 7° 16′, 35° 23′, 5950, 6.ii.27.
54. Saki (Shaki) R., Mocha district. 7° 26′, 35° 26′, 5800, 22.ii.25, 5.ii.27.
55. Anderacha. 7° 31′, 35° 25′, 7900, 2–3.ii.27. (This is a different position from Anderacha on the War Office map, which is close to Bonga.)
56. Ganji R. 7° 39′, 35° 27′, 5500–6700, 7, 10, 19.ii.25, 26–27.i.27.
57. Kella, Baro R. Province. 3650, 2.ii.25; Nado's Province, 5600, 9.ii.25.
58. Atla Kella. 7° 40′, 35° 27′, 7600, 24–25.i.27.
59. Haeto R. 7° 48′, 35° 27′, 6900, 8.ii.25, 23–24.i.27.
60. Alga. 5900, 17.ii.25.
61. Doa. 7° 55′, 35° 27′, 22.i.27.
62. Guracha R. 2650, 11.iii.25.
63. Gerba Dima, Didu district. 7° 57′, 35° 8′, 6000, 19.ii.25, 21.i.27.
64. Gore. 8° 9′, 35° 33′, 6600, 15.ii.25, 4–11.i.27, 31.i.27.
65. Below Gore. 6000, 7–31.xii.26, 3–8, 12–14.i.27.
66. Chabera. 6° 50′, 36°, 16.i.25.
67. Haba Mt. 5500, 14.iii.25.
68. Below Haba. 2000–3000, 13.iii.25. } ?Jaba, which is west of Maji.
69. Grine. 4000, 2–4.iii.25.
70. Berahan. 3800, 5.iii.25.

The following localities, among those visited by Dr. Hugh Scott, supplied the Rhopalocera which have been studied for the purposes of this account. The description except for B. and K. is taken from Scott's introduction (1933) to the paper on Hymenoptera by sundry authors.

A. Nr. Addis Alem. 26.x.26.
A.A. Between Addis Ababa and Addis Alem. 18–19.x.26.
B. Bishoftu, or in full, Lakes of Addas Hora Bishoftu, 39° E. just north of the railway. 7000 ft., 3, 5.xii.26.
C. Chillalo Mt., the westernmost of the high Arussi Mts. immediately east of Lake Zwai. 8000–9500 ft., 11, 14–16, 18, 23, 27.xi.26.
D. Doukam, station on the railway about 25 miles south-east of Addis Ababa. 6500–7000 ft., 16–20.x.26; 29.xii.26.
Dj.–A. Between Addis Alem and Djem-Djem. 20.ix.26.
Dj. Djem-Djem forest, about 45 miles west of Addis Ababa. 8000–9000 ft., 21–23, 25–29.ix.26; 1–3, 7–10.x.26; 14–16.xi.26.
D.L. Debra Libanos. About 35 miles north of Addis Ababa. 1–3.x.26, 2.i.27.
H. Harar. 9° 25′ N., 42° 5′ E., circa 6500 ft., 25.i.27.
K. Katter R., N.E. of L. Zwai, flowing into L. Zwai. 6000 ft. 5.xi.26.
M. Muger R., about 30 miles west of north from Addis Ababa. 5500–5600 ft., 29.xii.26.
W. Wachacha ravine, a few miles from Addis Ababa. 8000 ft., 9.ix.26.
Zq. Mt. Zuquala, 8° 31′ N., 38° 50′ E., about 40 miles from Addis Ababa, Wambar Mariam. 6000–9000 ft., 25–29.x, 28.xi.26.
Zw. Lake Zwai, plains N.W. of, 5500–6000 ft., 3–4, 1, 3–5, 7.xi.26.

The following localities were visited by Mr. G. H. Bullock.

Ad. Addis Ababa. 14.i.25.
Al. Albasso camp at 9850 ft. on the south slope of Mt. Chillalo. 29.xii.24.
G. Gurage Province. 6500 ft., 12.i.25.
H.B. Hawash Bridge. 15.i.25.

H.R. Hawash river, east bank, north edge of Gurage Province. 14, 15.i.25.
L. "Lake Langana," south-east and south-west shores of, 8.i.25; and three miles east of, 7.i.25. 6000–6900 ft.
Mk. Mukki or Makki R., flowing into L. Zwai. 6500 ft., 10, 12.i.25.

Subsequent allusions to these localities are by number in the case of Hodson's specimens, and by the letters as given above for those collected by Scott and Bullock.

SECTION III. SPECIES AND FORMS KNOWN FROM ABYSSINIA, AS DEFINED IN SECTION II.

The following catalogue follows the order adopted by Aurivillius *in* Seitz (1925). I consider this arrangement to be more useful to the majority of readers than that of the "Lepidopterorum Catalogus" which is not yet completed, and contains neither descriptions nor illustrations.

As explained in Section I above, the generic and specific names used in the following list have been revised by Mr. Francis Hemming and Mr. N. D. Riley. Where the names here used differ from those employed by Aurivillius, the names used by the latter author are indicated in footnotes (in the case of generic names) and in the text (in the case of specific names and names of lower rank).

The distribution given by Aurivillius for each species or form is given in inverted commas: unfortunately he was not so well informed about British territory in East Africa as about West Africa, and his distribution of many species is very incomplete. Therefore, when considering in Section IV the interpretation of this catalogue and selecting certain species for more detailed consideration, I have amplified the data.

In the following catalogue subspecific names are given only (*a*) where the subspecies found in Abyssinia is not the nominotypical subspecies, (*b*) where two subspecies of a single species occur in that country, or (*c*) where it is desirable for some special reason expressly to state that it is the nominotypical subspecies of a particular species that is found there.

PAPILIONIDAE.

Papilio rex abyssinicus Poult.

Hodson. 1. Loc. 56 (7.ii.25).

This single male specimen described by Poulton (1926, p. xliii–xliv) differs from other forms of *rex* by the straight outer margin, and the elongated shape, of the fore-wing: the expanse is 130 mm. The form *franciscae* described by me (Carpenter, 1928, pp. 28–9, and Pl. II) has a curved outer margin which is better shown in the male, and an expanse of wing in the male between 109–131 mm., the mean for seven specimens being 120. The chief feature of the coloration of *abyssinicus*, namely the reduction to a minimum of the amount of orange-brown in the sickle-shaped mark of area 1*b* at the base of the fore-wing, can be matched among specimens of *franciscae*.

Papilio rex franciscae Carptr.

Scott. Male, 1. Loc. Dj. (25–29.ix.).

It is interesting that the only specimen of *rex* captured by Scott in the central highlands should be the form *franciscae* which occurs in the south-east Sudan, and is not the form captured by Hodson in the part of Abyssinia nearest to the Sudan. Scott's specimen has an expanse of 115 mm. and a markedly curved outer margin to the fore-wings, the "mealy patch" in area 1*b* at the end of the sickle-shaped white mark is as in other *franciscae.* But in the amount of orange-brown, which is reduced to a very slight trace along the posterior (or inner) edge of the sickle, and a narrow line across the base of that mark, it shows no difference from *abyssinicus.* This is a convenient opportunity to refer to a further series of *franciscae* given to the Hope collections by Capt. I. G. Owen of the Sudan Defence Force, who captured them at Nagichot, Didinga, the type locality, in October and December 1933. Four males all show a well-marked concavity of the outer margin. In two the " sickle " mark is brown; in the other two there is no trace of brown. The single female only shows brown in the small " sickle " and a faint trace at the base of the cell.

The fifteen males of this form that are now mentioned agree in the curvature of the fore-wing, and it is much to be hoped that other specimens with a straight margin will soon be forthcoming to show whether the single *abyssinicus* is or is not an abnormality. The three large pale markings at the base of the hind-wing are, on the under surface, white in *abyssinicus,* Scott's *franciscae* and the five recently received *franciscae.*

Papilio dardanus Brown.

Hodson. Males, 97. Females, 11. Locs. 2, 3, 5, 6, 8, 11, 13, 19, 39, 42, 43, 45 (1927), 47, 54 (1927), 55, 56 (1925), 57 (Nado's), 59 (1927), 61, 63 (1927), 64 (9–11.i.27), 65 (10.xii.26, 13.i.27).

Scott. Males, 15. Female, 1. Loc. Dj. (21–23, 25.ix.26, 1–3, 7–9.x.26).

The males of the forms of *dardanus* inhabiting N.E. Africa (Jordan, 1905; Rothschild and Jordan, 1905, p. 187) have one feature in common by which they can be separated from those of the Sudan, Uganda, Kenya Colony, and all other parts of Africa. The distinction lies in the character of the border between the apical black and central yellow areas of the fore-wing which, in the *dardanus* from most parts of Africa sweeps in an even curve from the tornus to meet the costa through area 8. Specimens from N.E. Africa, however, show an irregularity caused in area 7 by a bay of yellow projecting for a considerable distance into the black towards the subapical spot. Sometimes the bay runs into and fuses with the spot on one wing or both (Pl. VIII, fig. 5); the name f. indiv. *extensiflava* has been given to this by Le Cerf (1924A, p. 378), who points out that it occurs in most of the races of *dardanus.* The bay would, therefore, seem to be an ancestral feature which has been preserved in the somewhat isolated north-eastern races (*cf.* Eltringham, 1917). It is noteworthy that in *P. phorcas* Cr., which Le Cerf (1924A, p. 370) places as the nearest species to *dardanus*, the bay in area 7 is represented by a well-marked pale area which in some specimens of the yellow form of female (*thersander* F.) stretches out towards the subapical spot in the same way, and supports the view that the north-eastern *dardanus* are of an ancestral type. I am obliged to Mr. G. Talbot for the reference to Le Cerf's paper.

The other continental races of *dardanus* provide occasional specimens with a slight development of a pale area at the base of area 7 (Pl. IX, fig. 12), usually quite a small patch filling the apex of the triangle. An interesting family was bred by Leigh at Durban (Leigh, 1904) from a male parent showing this character which was only reproduced in one of the six male offspring. Poulton in his analysis of this family (*loc. cit.* pp. 682–5) mentions that the " interrupted black submarginal band of the hind-wing of the male is ancestral as compared with the continuous band." The north-eastern forms have this band much interrupted; in some cases (*byatti* Poult.) it is reduced to the two spots forming each end of the band, and it is therefore interesting to note that the primitive race *meriones*

Fldr., in which the black submarginal band of the hind-wing is much interrupted, has the apex of area 7 on the fore-wing occupied by yellow.

A second characteristic of the north-eastern races was pointed out by Poulton (1926A, pp. xlv–xlvi), namely the manner in which the inner edge of the black border of the fore-wing shows projections into the yellow *between* the nerves. In the case of *byatti* (Pl. VIII, fig. 3) this is particularly well shown in areas 1*b*, 2, and 3, so much so that the yellow seems to penetrate almost to the edge of the wing along veins 2, 3, 4. A specimen of *polytrophus* R. & J., from the Nairobi area in Kenya colony, captured in 1904 by C. F. Elliott and presented by him to the Hope collections, agrees with *byatti* in this peculiarity and approaches it also in others (Pl. VIII, fig. 4): possibly there has been an admixture of races. The same invasion of black by yellow along the veins gives area 8 a characteristic appearance in all the north-eastern races, though not in *meriones*, curiously enough.

The north-eastern races cannot be sharply distinguished from each other, but they can be separated by the general colour of the underside of the hind-wing and of the apex of the fore-wing of the male. Broadly speaking, *byatti* inhabits the most eastern area, Somaliland proper, while *antinorii* Oberth. occupies Abyssinia and Eritrea, varying considerably in appearance.

The race *byatti* (Pl. VIII, fig. 3) was described from the following features (Poulton, 1926A, pp. xlv–xlvi). Fore-wing, apex more falcate, outer margin with a deeper bight, internal edge of black border projecting *between* the veins: hind-wing, greater reduction of black markings than in any other form, tail entirely without black and strongly tinted with orange. No mention was made of the characteristic underside which is of a russet-brown, with the spots of a darker shade of brown and the three lines in the cell of the hind-wing not black as is usual in *dardanus* but only slightly darker than the ground-colour. The nearest approach to this russet-brown is shown by *tibullus* Kirby, which has, however, a much stronger pattern. There is little doubt that *byatti*, from the Golis mountains of British Somaliland, can be separated as a distinct race.

It has been necessary to consider what was meant by the names *antinorii* Oberthür, *alticola* Boullet and Le Cerf (1912) and *hodsoni* Poulton (1926A).

The north-eastern specimens of *dardanus* were first separated by Oberthür (1883) and a figure given of a female which was the first male-like female to be discovered outside Madagascar; the description of the male is very inadequate and is given in the following words on p. 714. "Il *P. Merope-Brutus* d'Abissinia, ora *Antinorii*, Oberthür, è adunque la forma meno melanica di tutta l'Africa continentale ed insulare. La coda è sprovvista talvolta di qualunque traccia di nero; più sovente però si osserva una piccola linea nera nervaturale. La femmina si riconosce dal maschio soltanto per la macchia costale e cellulare molto meno pronunziata che nel *Meriones*. I *P. Antinorii* furono presi a Feleklek (20 Luglio, 4 e 16 Ottobre, 30 Novembre 1879 e 16 Giugno 1880) e a Sciotalit (29 Settembre 1879)."

In a sentence on p. 713 of the same paper Oberthür also says: "Appena le ali inferiori hanno le macchie anale e costale." An earlier account of specimens collected by Raffray was given by Oberthür in 1878 (*Études d'Entomologie*, **3**: 11) in which he clearly notices the peculiar character of the inner edge of the black margin of the fore-wing; "la bordure noire de l'aile supérieure est étroite." Unfortunately he did not mention this in the formal description of the new subspecies, nor did he designate a type specimen in his description.

The next description of a male *dardanus* from Abyssinia was by Boullet and

Le Cerf (1912) who named a form *alticola*, of which the following was the chief character : " aux ailes inférieures, les taches noires geminées de l'angle anal sont très larges et reliées à la tache costale mediane par une série de taches discales irregulières comme chez certains individus de *P. dardanus dardanus* Stoll " : other minor differences were mentioned.

Specimens from south-west Abyssinia were named *hodsoni* by Poulton (1926A), who pointed out that the males " differ from those of *d. antinorii* by an increase in the black markings, *antinorii* being intermediate between *byatti* and *hodsoni*." Considerable stress was laid on the hind-wing : " the marginal, submarginal and discal black markings, although excessively variable, are heavier than in *antinorii*, which in this respect is often nearer to *byatti* than to *hodsoni*." The amount of pigmentation on the tail was discussed, and it was considered that a certain specimen from east of Lake Abaya, in which the tail was pigmentless and the black markings much reduced as compared with *hodsoni*, was of the form *antinorii*.

The separation of *hodsoni* from *antinorii*, however, was made without examination of the type of the latter, and Oberthür's description is inadequate. The specimen selected by Poulton as type is shown on Pl. VIII, fig. 1. It appears from the descriptions that *hodsoni* cannot be distinguished from *alticola*, the chief character of both being a greater development of the black spots on the hind-wing than in *antinorii*, though it was not clear to what extent they are developed in the type of *antinorii*. When I examined the whole series of 97 males collected by Hodson in S.W. Abyssinia it appeared that 79 had the ground-colour of the underside of the hind-wing and of the apex of the fore-wing of a strong orange colour, differing considerably in depth from the yellow of *dardanus* outside Abyssinia. The 97 specimens showed such variation in the development of black on the hind-wing that it appeared that the only means of separating *hodsoni* from *antinorii alticola* was by the orange underside. It was presumed that *antinorii* had an underside like that of other *dardanus* since no mention of difference was made by Oberthür, Boullet and Le Cerf, or Poulton, and that the strong orange colour was characteristic of *hodsoni*.

My attention having been directed by Mr. E. B. Ford to the males mentioned by Kheil (1890) as associated with his forms of females from Lake Tana, the help of Professor Jan Obenberger at Prague was sought. He most kindly forwarded one of Kheil's males, which was almost identical with the type of *hodsoni* both on the upper and under surfaces.

The question then arose whether the type of *antinorii* was orange or pale on the underside. Mr. J. Levick kindly sent me one of Oberthür's specimens from Feleklek, dated " 16 Giugno 1880," which is thus one of the series from which he described *antinorii*. It was as strongly orange as the type of *hodsoni*.

Inquiries addressed to the Museo Civico di Storia Naturale, Genova, in the Bulletin of which Oberthür described *antinorii* (1883) resulted in the information, kindly supplied by Dr. Emiglio Berio, to whom I am greatly indebted, that a specimen dated 20.vii.1879 from Feleklek bore the label by Oberthür " *P. antinorii* exemplare tipo." This specimen has the underside deep orange-yellow : it differs from the figure given by Aurivillius (1925). An accurate drawing which Dr. Berio most kindly sent clearly shows that the type of *antinorii* has the black markings on the disc and border of the hind-wing, and on the tail, almost exactly like those of the type of *hodsoni* ; and the orange underside also is like that of *hodsoni*.

The use of the name *hodsoni* must therefore be abandoned, and in my opinion *alticola* cannot be upheld as a race or subspecies.

The following are the very small points in which the holotype of *antinorii* differs from the specimen shown on Pl. VIII, fig. 1.

1. The black spot at the apex of the hind-wing is slightly larger, and the isolated spot in area 6 is slightly nearer the margin.
2. The black spots forming a more proximal and a more distal pair at the anal angle are united along vein 2.

The size and position of the other spots and the amount of black on the tail are as in the figure. So also is the degree of development of the irregularities projecting into the yellow of the fore-wing from the inner edge of the black border. Dr. Berio informs me that in the Genoa museum there is another male from Feleklek, 16.vi.1880, which " ressemble beaucoup le ♂ du Seitz" : this has the underside of the hind-wings " d'un jaune orangé très pale."

The orange underside is strongly developed in 58 of Hobson's specimens, less strongly in 21. The development of the black markings was examined in these 79 which were at first considered to be distinct from *antinorii*. The markings on the hind-wing are more developed than in the type specimen of *antinorii* in 50 specimens, equal in 27, and less in 3. This suggests that the specimens from the south-west are more heavily marked than those from further east or north, and to some extent confirms M. Le Cerf's conclusions in MS. that typical *antinorii* inhabits the less mountainous and more open areas to the north and east of the central plateau, while form *alticola* inhabits the more mountainous wooded areas to the west of the plateau. But the forms are not clearly separated geographically. The Tring Museum possesses 6 specimens from " Salomona, Eritraea, 11.xii.1897, Shrader," which are extremely lightly marked; 2 examples having no black spots on the hind-wing except at the costal and anal angles, 2 having in addition only a minute spot in area 6, and 2 having besides a spot in each of areas 4 and 5 : these very lightly marked specimens agree with others from the Gillett Mts. south of Harar. On the other hand, another specimen from the latter locality has the black markings as well developed as in the type of *antinorii*.

An unusually heavily marked specimen captured by Hodson at locality 13, at only 2300 ft., has the hind-wings of the ordinary appearance of nominotypical *dardanus* from south Sudan and Uganda, on both surfaces. The fore-wings, however, show it to have at least some of the Abyssinian characters : it strongly suggests a hybrid between nominotypical *dardanus* and form *antinorii* (Pl. IX, fig. 8). Among the 15 specimens captured by Scott in the eastern highlands only 2 have the black markings less developed than in the type of *antinorii* : as regards the orange underside only 2 display that character.

Since the orange underside is found among specimens from all parts, even Eritrea, L. Tana, and the Djem-djem forest, together with the paler forms, it cannot be used to separate a geographical race. M. Le Cerf kindly informs me that, of the four specimens on which the name *alticola* was founded, one from Tchora agrees with two others from Yambo in Gaba province in its strongly orange underside, while another from Tchora has it whitish. There remains the question of the black markings on the tail which are extremely variable and seem to be made up of two components.

A. The median vein, which may be simply blackened very slightly all along its course, may be thickened near its end (Pl. IX, fig. 7), or may in addition, as in the type of *antinorii*, have a rounded, ill-defined, black mark on its outer side (Pl. VIII, fig. 1).

B. An extension along each edge of the tail of black from the arched marginal markings on each side of the base (Pl. IX, fig. 12).

Complete fusion of all these produces a tail wholly black as in *humbloti* Oberth., although even here a few yellow scales can be seen at the extreme tip just internal to the vein. Type B is shown by *meriones* and *tibullus* in its full development; as one traces the transition from *tibullus* to *polytrophus* one finds the marginal "arch-markings" becoming gradually diminished to form a narrow black line along the edge of the base of the tail on its *inner* side, as in the specimen already mentioned which approaches *byatti* in some respects (Pl. VIII, fig. 4). The memoir by Leigh (1904, Pl. XXXI) gives a clear picture of this type of tail marking in its various grades of development, and the male figured by Poulton (1924, Pl. II) shows one with marginal arches moderately well developed. Pl. III in Poulton's paper gives the maximal development as shown in *meriones*.

Thus it appears that in the eastern and southern races the tail has heavy black *marginal* markings, with a median blackening along the vein that may or may not be shown: the marginal markings tend to disappear in the more lightly-marked *polytrophus* and remain longest on the *inner* margin (Pl. VIII, fig. 4). The western race *dardanus* Brown, however, has a characteristically different black marking of type A on the tail, and this is the form which extends into Uganda and south Sudan, meeting *polytrophus* on the east side of L. Victoria (Poulton, 1924, p. 10, and Jordan, 1905). The typical western form is shown in Pl. IX, fig. 7. The median line only is beautifully shown in specimens from Fernando Po, which in this respect differ much from *meriones*, although Eltringham (1916) has shown that in the shape of the black border of the fore-wing they agree with *meriones*.

The specimens of *dardanus* collected by Hodson show the *western* type of tail marking clearly: in only 6 is there a black marking, derived from the arches, along the inner side of the tail, and not strongly developed. The difference between markings of type A and type B is not merely an indication of a greater or smaller tendency to general development of black, for in western specimens in which the black markings are heavier, the increase of black is shown by a greater thickening of the black vein or enlargement of the black spot on its *outer* side. Contrast figs. 7, 8, 12. Thus it seems that the *dardanus* of south-west Abyssinia are allied to the western race.

Regarding the males captured by Scott, it was pointed out that only 2 of his 15 have the orange underside so common in the south-west.

It is therefore worth noting the character of the black markings of the tail in Scott's specimens, only 8 of which have the tails preserved. One of those with orange underside has the marginal "arch-marking" strongly developed, the other has no black on the tail at all. Among the remaining 13 with pale underside only 3 have the "arch-marking" undeveloped at the inner side, while in 3 it is strongly developed. These specimens from central Abyssinia show, therefore, a closer relation with the eastern races of *dardanus* than do Hodson's specimens from south-west Abyssinia (compare fig. 2 with 4 and 13).

There remains one small feature to be discussed, namely the presence of a small black spot on the discocellular vein of the fore-wing at the base of area 5 (Pl. IX, figs. 8 and 12). The variation has been named f. indiv. ♂ *discopunctatus* Suff., and is figured by Le Cerf (1924A, Pl. I, and p. 376). The spot reaches its maximum in the race *tibullus*, at Kibwezi, Kenya Colony, whence comes Le Cerf's figured specimen. (N.B.—It is described as *dardanus cenea*, but the heavy and complete black band suggests *tibullus*.) The 30 male *tibullus* from Kibwezi in the Hope collections show this spot heavily marked in 8, clearly in 11, present as a trace in 5, leaving only 6 without a trace. This spot is not shown in *humbloti* (one specimen) or the 33 ♂ and 12 ♀ *meriones* in the Hope collections, which indicates that it is not merely due to general accentuation of the black markings. It is found in continental *dardanus* of all races except *byatti*; it is clearly shown in 3 of Hodson's, faintly in 2; in the male-like females it is clearly shown in 3 of the 7, faintly in 3 others. The 15 males collected by Scott show only a minute trace of the discocellular spot in 3 specimens. Its presence in primitive Abyssinian females (Pl. IX, fig. 9), but its absence in *meriones*, together with its widespread distribution, suggest that it developed in an early continental race of *dardanus*.

The characters of Scott's males have been mentioned, but one feature requires attention. The tail-markings are less western in character than in Hodson's, indicating that the former are nearer *polytrophus* than are the latter. The wings are broken in 5 specimens, in 7 there is an inner marginal black marking derived from the arches, while in 3 only is there none.

We now come to the consideration of the primitive, male-like, females of the north-eastern races.

The female of *byatti* is not yet definitely separated. There is in the Hope collections a single specimen in very poor condition, from the Arusa-Galla country. It has not the russet-brown underside of the male, and the three lines in the cell of the fore-wing on the underside are black. The general tint of the underside is very pale yellow, like that of the upperside. The tails, which are much damaged, appear to have been very slender and without black markings: the discal and marginal markings are better marked than in the male: there are large spots in areas 4, 6, and 7, and a smaller spot in 5. On the fore-wing the costocellular black does not pass backwards behind the middle of the cell. The chief interest lies in the pale spots in the black border of the fore-wing, characteristic of the north-eastern races of *dardanus* (Pl. IX, figs. 10 and 11): one lies in each of the areas 1*b*, 2, 3, 4, 5, 6 at the edge of the black, and in 1*b* and 3 communicates with the discal yellow. These spots are visible on both sides. It is to be noted that these pale intrusions into the black are not the same as the indentations along the nervures in the male (vide supra). Two specimens from Somaliland in the British Museum have the underside very pale; the tails are slender and in one of these the linear markings in the cell of the hind-wing are brown as in the male *byatti*. In this specimen the submarginal pale spots in the border of the fore-wing are only visible on the under surface, and in areas 2 and 3: the costocellular black bar on the fore-wing is continued backwards almost to the posterior border of the cell.

This specimen from "Duras, 5000 ft., British Somaliland, 11.xii.19," may represent the female of *byatti*, as distinct from *antinorii*. The second specimen with slender tails has the intra-cellular lines on the under surface of the hind-wing black and not brown. The submarginal spots of the fore-wing are only shown on the under surface, and as bays in areas 2–3: this specimen comes from "Dara-as, Goolis Mts., 8.iii.95."

The female of *antinorii* was, as previously mentioned, first described by Oberthür (1883), who was content with an illustration and the words already quoted.

In his description Oberthür did not designate any specimen as the type of the female, but through the kindness of Dr. Emiglio Berio I am able to state that the female allotype exists in the Museo Civico at Genoa, labelled "Sciotalit 29.ix.1879," and is the actual specimen figured by Oberthür. Dr. Berio remarks that this is " bien differente de celle du Seitz " : the latter has a large club-shaped costocellular bar.

Hodson collected seven male-like females. The two which are least differentiated from the male do not show submarginal spots on the upper surface: one of them, a heavily marked specimen from locality 8, shows small spots in areas 2 and 3, the other, in 3 only, on the under surface. The other five specimens show spots visible on the upper surface in areas 2 and 3, except in one case. These five show an extension of the costocellular black area of the fore-wing, in gradual series of which the last member shows on the under surface a suffusion with black along area 3 to reach the margin of the black border (Pl. IX, fig. 11). This is particularly interesting as suggesting that the mimetic resemblance may have begun on the under surface by this small suffusion which, when better developed, produces the well-known transitional female form *trimeni* Poult. The last named specimen agrees in this character with a strikingly interesting female of *meriones* figured by Le Cerf (1924A, Pl. I, and p. 379). Strengthening of this important feature has produced mimicry, for in the model *Amauris niavius* L. the black area separating the two main white areas on the fore-wing occupies the same position along vein 3. It seems possible that, for reasons connected with the process of formation of the wings, there is a tendency for the production of a black area along vein 3 which has been seized upon by Natural Selection and intensified in *dardanus* to produce the detailed mimicry in *hippocoon* F. Owing to this tendency the greater part of the pale bays in areas 2–3 has been destroyed by black pigment; but in area 4, anterior to the part which tends to become black, the pale bay has been preserved in *dardanus* as in the model.

A very interesting female in Lord Rothschild's collection at Tring shows this first degree of suffusion with black on the *upper* side in area 3, and very faintly also in area 4.

Another interesting series is the development of black suffusion beyond the end of the costocellular bar, at the origin of vein 10, and gradually extending towards the end of the bar to enclose a pale spot. This shows that from the very beginning the pale area of the wing within the cell immediately beyond the end of the costocellular bar, has been cut off and surrounded by black, to become one of the important details of the mimicry of *Amauris niavius* L. by the form *hippocoon* F. It is so deeply rooted a feature that it has not been obliterated even in cases in which its presence distinctly militates against the likeness to the model, as in forms *trophonius* Westw. and *planemoides* Tr. and its allies.

To return to the submarginal spots in areas 2 and 3 which are highly characteristic features in the fully developed mimetic forms. They appear to be peripheral portions cut off from the discal yellow which, in *meriones* and many males of the north-eastern races and elsewhere is deeply bayed into the black border. It is therefore interesting that the bay in area 4 which is shown in the illustration of the allotype female *antinorii* (Oberthür, 1883), and occurs in two of Hodson's females (which have the black in the cell most developed around the pale spot there), does not become cut off, but forms the posterior portion of the large pale mark which lies in area 4 and is a prominent feature in the mimetic resemblance. There seems to have been a tendency to form a whole series of such submarginal spots in the black border, cut off from the discal yellow, and some very interesting male *polytrophus* in the Hope collections, from Nairobi, show this very well. In one specimen there is a pale submarginal spot in each of the areas from 1*b* to 7 (Pl. X, fig. 13). This aberration has received the name *maculatus* Suff: and is figured by Le Cerf (1924A, Pl. I, and p. 376): when most developed it adds to the features by which *dardanus* resembles its close ally *phorcas*, whose yellow female, form *thersander*, probably the ancestral form, shows them very clearly.

The single male-like female captured by Scott (Pl. IX, fig. 10) differs from all of Hodson's in the small development of the costocellular black bar in which it agrees with the picture of the allotype female *antinorii* (Oberthür, 1883) and with another female, labelled " Abyssinia " with no further data, in the Hope collections. The bar is not only very narrow, but is so little thickened at the end that its tip does not reach back into the cell for more than one-third of the width of the cell. On both surfaces the submarginal pale markings of the fore-wings in areas 2 and 3 are widely open bays as in the illustration: the subapical spot is extremely small. The tails of the hind-wing are somewhat orange-tinted, and have an ill-defined black spot on the outer side: the inner " arch-marking " at the base of the tail is very faintly developed.

There is no constancy in the degree of development of this costocellular bar by which the south-western specimens may be distinguished as a race. Every grade can be seen between such a minimal amount as is shown in Scott's specimen (Pl. IX, fig. 10) and the thick bar with heavily clubbed extremity almost touching the median nerve posteriorly (Pl. IX, fig. 8). Specimens at Tring with slight and great development of the costocellular bar come from the same locality, " Kankati, Djimma." Another from " Abul Cassim " near Harar has the clubbed tip as well developed as in many of Hodson's specimens from the south-west, but one from Gine (Ginir) has a remarkably slender costocellular bar the distal half of which, projecting into the cell towards the base of area 4, is as narrow as the basal half along the costa, and is separated, from the angle where it bends outwards into the cell, by yellow from the subcostal nerve.

Hodson's females which show mimetic pattern (Pl. X, fig. 14) have been described by Poulton (1926A, 1926B, 1927A, *wienholti*, 1928A), but attention is here again directed to the very important discovery by Poulton that the evolutionary history of the development of mimicry of *Amauris niavius* has been different in Abyssinia from that in the southern races (1928B); and that these races support " Darwin's argument that the path of evolution was never repeated, or identical species produced twice over along independent lines." This discovery causes reconsideration of a view previously expressed (Poulton, 1924, p. 7) that the tailed females with mimetic pattern are " hybrids between the female *antinorii* and a wandering male from further south, carrying the factors for the females *trophonissa* and *hippocoon*."

The figure of *niavioides* given by Kheil (1890) differs from all specimens I have seen by the greater size of the posterior white patch on the fore-wing, which extends forwards into the base of area 3. There is no white in the base of area 3 in the three specimens at the British Museum, the two at Tring, and the three of Hodson's collection, described by Poulton: in one specimen at the British Museum the white extends as far forwards as vein 3 but not into the cell (*cf.* Pl. X, fig. 14). Moreover it appears from Kheil's figure of *ruspinae* that the pale pigment, in this case red-brown or yellow-brown, does not pass beyond vein 3, while in Hodson's unique specimen of *wienholti* (Poulton, 1928A) area 3 is also black at the base. Kheil's type of *niavioides* therefore appears to be unique. The white subapical bar of the fore-wing varies in different specimens of *niavioides*. The three spots of which it is formed may be so fused that the nerves running between them alone separate them, and their proximal edges may almost form a straight line as in Pl. X, fig. 14. On the other hand, their ends may be sharply bevelled at each angle so that they are pointed, and black scales along the nerves may separate three distinct spots.

The females captured by Scott were described by Poulton (1927B), two are of the *niavioides* form; one has long tails, one shorter tails: in both the broad dark border of the upper surface of the hind-wing is nearly uniform black instead of exhibiting black markings in a fuscous ground as in Hodson's three *niavioides.*

Ungemach found *dardanus* common enough, though never very abundant, in the west and centre, at least as far to the east as the Goudder R. His males were always more heavily marked with black than *antinorii*: the black spot in area 4 of the hind-wing never absent: he noticed that some of the specimens on the underside of the hind-wing were " ocre-orange " while others were " ocre-jaune très clair." He also noticed the aberration *extensiflava.* His females were of the male-like form *niavioides*, and a form which he named *zaoditu*, " la forme caudée correspondant fort exactement à *benio* Suff."

Papilio echerioides oscari Rthsch.

" Abyssinia."

Hodson. Males, 39. Females, 3. Locs. 28, 34, 37, 39, 43, 45, 51, 53, 54 (1927), 61, 65 (9, 10, 17, 25, xii.26, 3–4.i.27).

A minor aberration is shown by one specimen in which the discal spot of area 4 in the left wing is divided into outer and inner portions by an antero-posterior black bar.

Ungemach records *oscari* as common in the west and reaching in the east as far as Goudder. An interesting male aberration has three small white submarginal spots on the fore-wing in the areas 1*b*, 2, and 3. This has not been seen in Hodson's specimens.

The discovery, among the specimens in the British Museum, of one collected by the late T. A. Barns in February, 1921, in Tanganyika Territory on the east side of the plateau of the great craters, on open downland with scattered trees, is of the greatest interest. So far as I am aware this is the only specimen captured outside Abyssinia, and the case of *Pieris brassicoides* Guér. (see p. 343) adds interest to this specimen.

Papilio echerioides oscari Rthsch. ♂ f. *leucospilus* Rthsch.

" Abyssinia."

Scott. Male, 1. Female, 1. Loc. Dj. (7–9.x.26).

These were sent to Lord Rothschild, who very kindly identified the form. The submarginal spots of the hind-wing are much smaller than in Hodson's *oscari.*

Papilio cynorta arnoldi Poult.

Hodson. Males, 32. Females, 7. Locs. 2, 3, 5, 6, 11, 13, 19, 41, 42, 43 (1925, 1927), 44 (1927), 45 (1927), 55, 57 (Feb. 2), 59.

This Abyssinian race was described by Poulton (1926, pp. xlix–liii), who says: " The male only differs from that of *c. cynorta* F., and *c. peculiaris* Neave, in the more emphasised white marginal spots of the hind-wing." The description was made from two males, but examination of the long series subsequently received has shown that the Abyssinian race has another character. The cream-coloured series of discal markings of the fore-wing commences anteriorly in area 7, the spot in area 6 being the smallest of the regular series extending back to the inner margin. This spot is variable in size, and may be altogether absent as in the form *norcyta* Suff. Careful examination of a great many specimens of *cynorta* in the Hope collections and in the British Museum, from as many localities as possible, shows that the spot is most developed in *arnoldi* and that *norcyta* is mainly West African in its distribution. Critical examination of 190 specimens at Oxford and in the National collection of *cynorta*, and the very closely allied *plagiatus* Auriv. which is extremely difficult to separate by a sharp line, from all parts of their distribution, shows that the Abyssinian specimens have the spots in area 6 most developed (Pl. XI, fig. 19). It is significant that it is only in Abyssinia that *cynorta* comes into broad contact with *echerioides*, the latter being, in Uganda and East Africa, a species only found on the highlands, while *cynorta* does not extend to South Africa except for Angola. It is also interesting that in two localities in Uganda where another species, *P. zoroastres homeyeri* Plötz having a large white mark in area 6, is abundant, in association with *cynorta*, the latter has on the average a larger spot in area 6 than in the neighbourhood of Entebbe where *homeyeri* is scarce. Further information on the association of *cynorta* and *homeyeri* in West Africa, with analysis of the possible influence of the latter upon the former, would be most interesting: it seems that in Angola, where both occur, the spot in *cynorta* is almost always absent, as in typically western specimens (Pl. XI, fig. 20).

In the following table the localities are given from east to west into the middle Congo region, and from north to south along the west coast. The three signs indicate the relative size of the spot in area 6 of the fore-wing.

Locality.	+	±	—
Abyssinia	25	7	
S. Sudan			1
Jinja (at source of Nile, *homeyeri* common)	15	5	7
Entebbe and Sese Isles (*homeyeri* scarce)	7	13	16
Buddu (west coast L. Victoria, *homeyeri* common)	3	2	4
Toro (western Uganda)		2	5
Stanley Falls Basankusu Kasai		2	9

Locality.	+	±	—
Sierra Leone	3	3	5
Gold Coast and Ashanti	4	7	6
S. Nigeria	2	6	2
N. Nigeria		1	
Cameroons	1	1	7
Fernando Po			1
Gabun			1
Angola	1		16

It is seen that in Abyssinia 78% have the spot very strongly developed, while it is absent in none.

In Uganda, in two areas where *homeyeri* is common, the spot is well developed in 50% and minute or absent in 42%; at Entebbe where *homeyeri* is scarce it is well developed in only 18% and absent in 44%. In the middle Congo region it is never strongly developed in the 18 specimens available, and in 14 of them minute or absent. The 50 specimens from the west coast have the spot well developed in 20% and minute or absent in 44%, in the remaining 36% it is feebly shown. The Angola specimens only show the spot well developed in one of the 17; in the rest it is minute or absent.

The view that the male *cynorta* in Abyssinia is influenced by the male *echerioides* is supported by the enlargement of the white marginal spots of the hind-wing which produces a similarity to the submarginal spots in *echerioides*. It is noteworthy that these enlarged marginal spots are well shown in the female and detract from the mimetic likeness to the local race of *Amauris niavius*: possibly they have been handed on to the female from the male.

The highly interesting females of *P. cynorta arnoldi* were described by Poulton (*loc. cit.*) as regards three specimens from locs. 36, 51, and 69. Others were subsequently received from locs. 3, 7, 44, 45, one from each. The characters noted by Poulton are tabulated for the 7 specimens.

Specimen from locality—	Main white patch on f.-w.		Apical spot larger than in *P. c. cynorta.*	Marginal spot in f.-w. area 7.		Submarginal spots present in areas—
	Ends at vein 2.	Oversteps vein 2.		Present.	Absent.	
69 (Type)	+		+		+	1*b*, 2, 3, 5.
3	+		+		+	1*b*, 2, 3, 4, 5.
7	+		+	+		1*b*, 2, 3, 5.
36	+		+	+		1*b*, 2, 3, 4, 5.
44		A few scales.	+		+	1*b*, 2, 3, 5.
45	+		+		+	1*b*, 2, 3, 4, 5.
51		Well marked.	+		+	2, 3.

The submarginal spots in areas 4–5 are never shown on the *under*side: in connection with what has been said under *dardanus* it will be noted that in this species also the spot in 4 is often lost in the black.

Ungemach found *arnoldi* chiefly at Youbdo, and has made some new points in his reasons for considering it a distinct species. He considers that the arrangement of the discal series of white spots in the male is a sharply differentiating character. In *arnoldi*, as shown by his figure (1932, Pl. I, fig. 2) the margins of the spots form two lines converging to a point beyond the spot in area 7, which thus lies within these lines: in *cynorta* the spot in 7 lies outside. Described in another way the difference lies in the line joining the outer ends of the spots being straight in *arnoldi* but bent inwards at vein 4 in *cynorta*. While this is true, it is not a strict difference, for among the series of 32 *arnoldi* in the Hope collections there are many in which the character of the line mentioned is intermediate between *cynorta* and the extreme *arnoldi*. But it is interesting to note that this departure from *cynorta* to *arnoldi* has brought about a greater likeness to *echerioides*, in which the line joining the outer edges of the spots is as straight as in *arnoldi* or even may be slightly bent *outwards* at vein 4.

Another difference from *cynorta* is stressed by Ungemach; the ground-colour in *cynorta* is " brun noir assez terne," whereas in *arnoldi* it is " d'un noir profond et pur, avec tout au plus une pointe de verdâtre." This is certainly the case, and adds a fourth character to those by which the Abyssinian male *cynorta arnoldi* departs from the typical form to resemble *echerioides* with which it is closely associated. I can find no difference between the male genitalia of *arnoldi* and *cynorta*, while they agree in differing from *echerioides* with which they were compared: it seems that the claim to raise *arnoldi* to specific rank can be met by strong objections.

Papilio constantinus Ward.

" Natal to Abyssinia."

Papilio nireus pseudonireus Fldr.

" Somaliland and Abyssinia."

Hodson. Males, 18. Females, 2. Locs. 3, 5, 8, 11, 26 (1924), 41, 44, 56, 61, 63, 65 (11, 13, 16.xii.26).

These have the band on the fore-wing slightly better developed than in typical Somaliland specimens and are transitional from the common East African specimens of *P. nireus lyaeus* Dbl. Somaliland specimens have paired white marginal dots on the fore-wing in cellules 1*b* to 6, which are marginal extensions of blue dots in *lyaeus* which lie in the same position but not reaching the margin. The females of the Abyssinian specimens may show these white dots, as may also *lyaeus* from Kenya, but the Abyssinian males do not.

Bullock took a single female at Addis Ababa.

Ungemach found it very common in the west and upon the Baro river, but apparently not passing east of the Ouama (about 36° 40′ E.) in January to May. He comments upon the variation in the breadth of the blue band: the white band on the underside of the hind-wing is never absent, as it may be in the following species.

Le Cerf (1924, p. 386) alludes to specimens from Eritrea as agreeing with *donaldsoni* E. Sh.: he would reserve the name for examples comprised under *pseudonireus* which lack the green spots at the extremity of the cellule and "l'intervalle 4 du disque," which are expressly indicated by Felder in the type of *pseudonireus*. He cites specimens of *donaldsoni* from Walenso and Darro Mts., which differ slightly in having the band on the posterior wings straighter and more cut up by black nerves which are almost absent on the fore-wings. He notices that they have in addition on the fore-wings submarginal points, yellow or less tinted with green; apparently the same feature to which reference has been made above.

Papilio aethiops R. & J.

"Somaliland and Abyssinia."

Hodson. Males, 21. Females, 1, plus one male with no data except 28.3. (probably 1925). Locs. 32, 47, 56 (1925), 61, 64 (10.i.27), 65 (10–13, 16.xii.26, 3.i.27).

Scott. Males, 5. Females, 2. Loc. Dj. (21–23.ix, 1–3.x and 7–9.x).

Bullock. Male, 1, 7.i.25. 3 m. W. of L. Langana.

Ungemach found it common throughout the west and eastwards as far as Goudder: he remarks upon the variable underside.

Papilio aethiops R. & J. ab. *elicola* Strand.

Abyssinia.

Papilio aethiops R. & J. f. **oribazoides** forma n.

Rothschild and Jordan (1905, pp. 190–1) have pointed out that "in two of our individuals the white postdiscal spots of the underside of the hind-wing are shaded over with brown, not contrasting much with the rest of the wing, reminding one of the Malgassic *Papilio oribazus*."

This form appears almost as common as the typical form, and the name *oribazoides* is given to it here: the type specimen was captured by A. W. Hodson at loc. 54, 22 February, 1925.

Hodson took males 16, females 3. Locs. 33, 54 (1925), 56 (7, 19.ii.25, 10, 11, 13, 15, 17, 20, 27.xii.26).

Scott. Male, 1. Loc. Dj. (7–9.x).

Papilio demodocus Esp.

"Common everywhere in Ethiopian Region."

Hodson. Males, 16. Locs. 19, 23 (27–8.iv.25), 25 (29.iv.25), 26 (1924), 34, 37, 51 (23.ii.25), 64 (15.ii.25), 65 (10–15.xii.26).

Common according to Ungemach.

Papilio pylades pylades F.

" Senegal, as far as the White Nile, southwards only to the most northerly part of the Congo State."

Hodson. One small male from loc. 31.

Papilio pylades baronis Ung.

Described as " commun dans la région d'influence soudanaise (Baro et Didessa). Nul ailleurs. Intermédiaire entre *pylades* type et *angolanus*."

Papilio latreillianus Godt.

" Sierra Leone."

One specimen of this typically West African species is recorded by H. Cannaviello from southern Eritrea, Godofelasse (1902). The identification appears to have been considered doubtful by other writers on distribution (Le Cerf, 1924c, p. 195, footnote), but is not impossible if the western affinities of the Abyssinian fauna be remembered.

Papilio leonidas leonidas F. and
Papilio leonidas umanus R. & J.

Ungemach found *umanus* rarely in Wallega and on the Didessa. One ♂, taken by Hodson at loc. 65 (3.i.27), is nominotypical *leonidas* Fab.

Papilio carchedonius birbiri Ung.

Only captured at Youbdo, in November 1926, two males.

Distinguished from *carchedonius* Karsch by a general reduction of the white pattern. It seems to be close to *uganda* Lathy, and according to the description only differs by the absence of submarginal spots, well marked on the hind-wing in *uganda*. In the " Lepidopterorum Catalogus " dealing with Papilionidae Bryk, 1930, places both *uganda* and *carchedonius* as forms of *Papilio almansor* Honr.

Papilio antheus nyasae Btlr.

" Natal to British East Africa."

Hodson. One male from loc. 41.

Ungemach considers that the Abyssinian specimens may be a distinct race having at the base of the hind-wing beneath " beaucoup moins de noir que les spécimens du Congo que je leur compare."

Papilio antheus nyasae Btlr. ab. *evombaroides* Eim.

Ungemach found this " rare dans le bassin de la Didessa et au Ouallaga (avril–mai)."

Papilio sisenna Mab. form ?

Cannaviello (1902) records two specimens from " Makalle, Godofelasse " in Southern Eritrea, which differ from those of Mozambique by the following characters, given in his own words. The difference is shown " by their spots of the middle band, in the fore wings, being smaller and of a rather more irregular shape of roundness. The two basal spots in the hind wings are shorter and less narrow, just as those of the marginal series. The appendage as a tail, in the same wings is grey dark on the over side, white on the under side. The red spots on the under side of the wings are of a darker colour, smaller and less round, and on the white spot standing near the anal side we see another yellowish spot which corresponds to a greenish spot larger on the over side. The general colour of the wings is black dark, whilst in the type it is of a fine black ebony." Cannaviello considered these to be a local form and it is thought advisable to draw attention to the specimens in order that the interesting record should not be lost.

Le Cerf (1924c, p. 195, footnote) doubts the authenticity of this record, but the fact that other examples of occurrence in Abyssinia of species from far to the south are known (e.g., *Papilio colonna*) somewhat strengthens this one. Moreover the especial attention paid to the "red spots," which are more developed in *sisenna* than in allied species for which it might have been mistaken, suggests a correct diagnosis: also it appears that Cannaviello compared his with typical East African specimens. The rarity of this species, and of *colonna*, both species of the south-east, in Abyssinia, as testified by the unique records, is significant, as will be seen later.

Papilio colonna Ward.

"Delagoa Bay to British East Africa."

Hodson took one male from loc. 22.

PIERIDAE.

Leptosia alcesta Stoll.

"Sierra Leone to Natal, British East Africa and Uganda" (for the species as a whole).

Hodson. 6. Locs. 21 (30.ix), 36, 45, 51 (23.ii).

Bullock took one near L. Langana.

Leptosia alcesta Stoll f. *nupta* Btlr.

Hodson. 11. Locs. 2, 33, 34, 44, 45 (4.ii), 57, 69.

Ungemach recorded one specimen from Youbdo.

Leptosia alcesta Stoll f. *nuptilla* Auriv.

Ungemach recorded this as common "depuis le Baro jusqu'à l'Alenga vers l'Est. Il ne paraît pas exister dans le Centre."

Pinacopteryx eriphia lacteipennis Btlr.[1]

"Abyssinia and Nubia."

Pinacopteryx eriphia lacteipennis Btlr. f. *iterata* Btlr.[1]

"German and British East Africa and Somaliland."

Hodson. Males, 5. Females, 2. Locs. 20, 21 (25.iv), 22, 23 (2–3.x), 25.

Ungemach only captured one specimen and saw another, "sur le Baro."

Pinacopteryx eriphia lacteipennis Btlr. f. *melanarge* Btlr.[1]

Hodson. Male, 1. Female, 1. Locs. 20, 23 (2.x).

Mylothris agathina Cr.

"From the estuary of the Congo in the whole of South and East Africa to Abyssinia."

---

[1] Placed by Aurivillius in the genus *Herpaenia* Butler

Hodson. Males, 6. Females, 11. Locs. 2, 11, 12, 14, 21 (30.ix), 23 (2–3, 10.x), 26 (10–15.ix), 34, 65 (23, 28.xii).

These Abyssinian *agathina* show little western influence, as there is no sign of transition to the heavier markings of *chloris*, which occurs at Entebbe, and even in the Mongalla Province of south Sudan. Indeed, in two males the apical black is rather reduced.

Scott. Females, 3. Loc. Dj. (21–23.ix, 1–3.x).

One of the females shows some reduction of the apical black. Ungemach notes it as little variable, common in the centre and in the west as far as Baro.

Mylothris erlangeri Pag.

" Abyssinia."

Hodson. Males, 11. Locs. 32 (18.i), 34, 54 (22.ii), 55, 56 (19.ii), 63 (19.ii), 65 (12.xii).

Scott. Males, 13. Females, 6. Loc. Dj. (21–29.ix, 1–3, 7–9.x).

Bullock. Male, 1.

Ungemach found it " dans le Centre et l'Ouest, mais non sur le Baro." The female may sometimes only be distinguished from pale females of *agathina* by the less pointed wings.

Mylothris rüppellii kikuyuensis Riley ♀ f. *kaffana* Riley.

The species occurs " from Cape Colony to Abyssinia."

Hodson. Males, 2. Female, 1. Locs. 26 (8.ix), 37, 44 (1.ii).

Ungemach found " *rüppelli* " abundant in the west outside the Baro country, rarer in the centre where it does not pass Tchellea.

According to Riley (1921 : 235) Koch described *rüppellii* from " Abyssinia," but Abyssinian specimens do not agree with his definition and are separable under the names given above. The female form *kaffana* is " so close to some female examples of *erlangeri* Pag., from Abyssinia as to lead one to think that *erlangeri* itself may be only an extreme yellow race of *rüppellii*." Two of Scott's females of *erlangeri* are very much paler yellow, which makes this possibility seem more probable. Ungemach mentions that " *rüppelli* " is extremely well imitated by " *Appias rhodope abyssinica* " of the same regions which does not seem to be the case with the race *septentrionalis* Carptr. (from the S.E. corner of the Sudan). In my paper published in 1928 (1928 : 31) *Mylothris rüppellii* was stated not to have been taken by Hodson : the error was due to the collection not having then been sorted out.

Mylothris rüppellii kikuyuensis Riley ♀ f. *kenia* Riley.

The British Museum possesses specimens from Yeddeb, Gedeb river, Godshara.

Mylothris mortoni mortoni Blach.

Hodson. 1. From loc. 50.

Scott. Male, 1. Loc. Dj.–A. Females, 2. Loc. Dj. (21–23.ix, 7–9.x.26).

These are transitional to the form *balkis* below, the spots not being completely fused to form a bar in the female.

Ungemach found it at Djem-djem, Gamo, and Lalokeli (Wallega).

Mylothris mortoni balkis Ung.

Differentiated as a western race from " l'Alenga " (?Alanga) by Ungemach as being " beaucoup plus chargée de noir " : in a female form which he names *continua* the spots completely merge into a continuous brown marginal band.

Mylothris rhodope-amhara Ung.

" Très commune dans l'Abyssinie centrale et dans l'Ouallaga."

Hodson. Males, 12. Females, 6. Locs. 24, 34, 44, 45, 52, 63 (1925).

The following note has been written for this paper by Mr. G. Talbot, who has kindly taken considerable trouble over the difficult subject.

Mylothris rhodope amhara Ung.

M. latimargo amhara Ung., 1932, *Mém. Soc. Sci. nat. Maroc,* **32** : 25.

The forms of *Mylothris* grouped under the names *rhodope* F. (= *spica* auct.), *yulei* Butl., *ertli* Suff., *latimargo* J. & T., and *amhara* Ung., constitute an assemblage which comprises probably only two species. Owing to the variability in pattern and also in the genitalia, it is very difficult to diagnose with certitude in every case. We have examined dissections of 20 specimens including the type of *latimargo*, a paratype of *ertli* from the original locality, of *yulei* from Nyasaland, *amhara* from Abyssinia, and *rhodope* from West Africa.

The clasper possesses a flap-like process on the inside. This process is more or less strongly sclerosed, and is attached to the clasper by a membranous base. The shape of this organ varies in species and in forms which appear to be races, but does not seem to vary among individuals of the same form. A comparison of this organ in the various specimens dissected indicates that *rhodope* and *yulei* are species which exist in three or more races.

We are concerned here only with the relationship of *amhara*. This appears to represent *rhodope* F. in Abyssinia as a strongly differentiated race. It is not related to *latimargo* as was formerly supposed, this insect being a race of *yulei*, in which the clasper organ is shorter and much broader.

Although *amhara* does look rather different to typical *rhodope*, and although the clasper organ is longer and narrower, this is not sufficient to give it species rank. If it were, we should have to give this rank to an obvious *rhodope* race from the Kivu region, in which the clasper organ differs even more.

The series of *amhara* in the Hope Department and the British Museum includes the female which was not mentioned by Mons. Ungemach. This sex is like the ♂. The basal area of the fore-wing above is very pale yellow. The two to four marginal spots are rounded and well defined. The underside is only slightly washed with pale yellow, but this coloration is probably subject to variation.

We must point out that the difference in genitalia mentioned by Mons. Ungemach in his description, lies not in the clasper itself but in the organ described above.

It may be said here that *latimargo* appears to be the Kenya race of *yulei*, and that *ertli* appears to be the race from Uganda, extending to Tanganyika Territory and Kilimanjaro.

In the British Museum (Coll. Joicey) is a female specimen resembling *yulei ertli* from Abyssinia. This specimen was purchased by Mr. Joicey from Mons. Le Moult, and came probably from an early collection made in Abyssinia by Mons. Ungemach. The ♂ of this insect should resemble *latimargo*, and in its absence we cannot be safe in considering the ♀ to represent another *yulei* race.

Mylothris rubricosta Mab.

" East Africa from Mozambique to Uganda and in the interior parts of the Congo region."

Hodson. Male, 1. Female, 1. Loc. 32 (18–20.i.25).

Ungemach agreed in finding this species rare : he took it at Harou, Lekamti and Gore. In my experience in Uganda and Tanganyika Territory this species is only found associated with papyrus : probably its food-plant in those countries grows among papyrus.

Mylothris sagala Smith.

" Peculiar to the mountainous districts of Africa."

Hodson. Males, 2. Locs. 38, 54.

These specimens of this extremely variable species have more black than the form *swaynei* Btlr. on the fore-wing, but the edge of the black is not markedly denticulate. The marginal spots of the hind-wing on the Bakida specimen are larger so that those in areas 6 and 7 are almost confluent : on the other they are larger than the rest, which are very small. The black is of a deep grey-black rather than the usual intense black. By comparison with a long series from Didinga, S.E. Sudan (Carpenter, 1928), the two Abyssinian specimens have less black and more white than the latter, which are nearest to *jacksoni* E. Sharpe.

Scott. Males, 2. Females, 4. Locs : Dj. 25–29.ix, 1–3, 7–9.x.

These are form *swaynei* Btlr.

Ungemach found the species " très variable, plutôt rare." He took it in the Centre and West but not in the Baro country. Two of the three males are like *swaynei*, the other corresponds with *narcissus* Btlr.

Appias sylvia abyssinica Talbot.

Ungemach found this very distinct Abyssinian race abundantly in all the west, including Baro, and more rarely in the east as far as Goudder, at the same time as *Mylothris rüppellii*, " qu'elle mime parfaitement."

Hodson took two males at loc. 34 which come very near to the race *abyssinica* Talbot (1932, p. 170) in having the black margin of the fore-wing narrower, but it is not completely resolved into spots on veins 2–6. The underside of the apex of the fore-wing is very near to that of *abyssinica*. This species is sometimes known by its synonym *Appias rhodope* (Dew).

Appias sylvia sudanensis Talbot.

There is in the Hope collections a specimen captured by Dr. A. J. Hayes at Lake Tana in February 1903 which agrees with the description given by Talbot (1932). The great amount of orange suffusion on the underside suggests that *sudanensis* is merely a dry-season form.

Appias sabina Feld.

" Sierra Leone to Angola."

Hodson. Males, 2. Loc. 19 (18–19.x).

These two on the whole are of this western race, differing from the eastern *udei* Suff. by the whiter hue of the underside.

Appias epaphia epaphia Cr.

Hodson. Males, 7. Females, 4. Locs. 3, 11, 18, 34, 35 (27.i), 36, 44 (1925), 51 (23.ii), 54.

None of the males has black marginal spots above or below: in some there is scarcely any yellow at the base of the fore-wing beneath. Others are transitional. They are near to *orbona* Bdv. (= *contracta* Btlr.), but the apical black is not much reduced.

Aurivillius gives "British East Africa and Equatoria" for *contracta, i.e.* for *orbona.*

Bullock took one female at L. Langana, 8 Jan. 25, which is much whiter than Hodson's, the fore-wing being white to the base of areas 1*a* and 1*b*, and the costo-cellular black not reaching the apical black: the subapical white spots are also larger.

Ungemach found this species in the whole of Wallega, and on the Baro abundantly. He noted the transition between the western ssp. *epaphia* Cr. and eastern ssp. *orbona.*

Appias epaphia orbona Bdv.

In the British Museum (Natural History), there is one ♂ from Abyssinia, taken by Zaphiro on the 23rd May, 1904, at Abobo, on the Akobo river.

Glycestha gidica westwoodi Wallengr.[1]

"South Africa to Abyssinia, the Sudan, and Senegal."

Hodson. Males, 7. Females, 5 white, 3 yellow. Locs. 3, 4, 17, 18, 19, 22, 23 (27.iv, 2–4.x, 13.x, 1925).

The wet-season form.

Glycestha gidica abyssinica Luc.[1]

"South Africa to Abyssinia and the Sudan."

Hodson. Males, 2. Females, 4. Transitional, not fully "dry." Locs. 21 (26.iv.25, 30.ix.25), 23 (4.x, 9.x).

Scott. Males, 9. Locs. A., Zw. (3–4.x), transitional to *westwoodi*; M., very "dry."

Bullock. Males, 6. Females, 3, from Addis Ababa, and banks of Hawash river; all of these are very "dry."

Female form *arida* Talbot. Specimens in the British Museum from the Akaki river and Lake Koye, Arussi.

Glycestha gidica hypoxantha Ung.[1]

Ungemach considers there are three distinct races, of which he described *hypoxantha* as new. "Elle est caractérisée chez le ♂ par le dessous des ailes post: qui est jaune clair vif, etc." Found at Baro, but in the Joicey collection there were specimens from the southern Sudan. The race *westwoodi* is found in the east of central Abyssinia and in the vicinity of Somaliland. A ♀ form *texturata* is found on the central plateau: "Dessus jaunâtre à jaune souffre pâle, dessins brun noirâtre. . . . En dessous . . . correspondant bien avec le type de *westwoodi.*"

The form *abyssinica* inhabits the same localities at the same time as *westwoodi*, but if this is so Ungemach can hardly be correct in alluding to them as "deux races distinctes de la même espèce." He found it abundantly in all the central part of Abyssinia from Addis Ababa to Billo in the west: it does not reach Didessa. A form, ♀ f. *crassilinea* is described, characterised by a yellowish colour with all the black pattern more strongly marked.

---

[1] Placed by Aurivillius in *Belenois* Hübn., which he treated as a subgenus of *Pieris* Schrank.

Glycestha creona boguensis Fld.[1]

" British East Africa and Abyssinia."

Hodson. Males, 9. Locs. 21 (30.ix.25), 23 (2, 3, 9.x.25, 27.iv.25).

Scott. Males, 6. Locs. A.A., Dj.–A., Dj. (25–29.ix, 1–3.x).

Bullock. Males, 4. Female, 1. At the bridge over Hawash river, 15.1.25; L. Langana, 7.i.25.

Glycestha creona boguensis f. *infida* Btlr.[1]

" German East Africa to Somaliland and Equatoria."

Hodson's captures include one female from loc. 23 (3.x). No males.

Scott. Males, 2. Female, 1. Locs. Dj.–A., Dj. (21–23.ix.26).

Glycestha creona boguensis f. *mixta*, Ung.[1]

Ungemach points out that *creona* and *severina* are inseparable, and that *severina* Stoll is the eastern and southern race. They are intermingled in western Abyssinia towards the Sudan, but the result is always nearer to *severina.* He has only seen a typical male *creona* on the White Nile outside the area he studied, although a typical female was captured in Wallega. The forms of *severina* most like *creona* are found on the Baro, and a form *mixta* is named " parce qu'elle unit les caractères de *creona* à l'aile ant. (point discocellulaire entrêmement réduit) à ceux de *severina* à l'aile post. (bordure identique à celle de *mesentina*). Le dessous est celui de *creona.*" Ungemach found *boguensis* " habituelle dans le centre et la lisière de la Somalie," but it occurs also on the Baro. All intermediates between *boguensis* and the extreme *infida* were found : everywhere from Addis Alem to Gambela.

Glycestha creona severina Stoll.[1]

" Common in the whole of south and west Africa, northwards to Angola and British East Africa."

Hodson. Males, 3. Locs. 23 (28.iv.25, 9.x.25), 26 (15.ix.25).

Two specimens are nearer to *creona*, having the hind margin almost unspotted.

Scott's captures of this species contain one male with certain characters of the dry-season appearance, from loc. M.

Bullock's captures include one male from the bank of the Hawash river, at the bridge, on 15th Jan. 1925.

Glycestha creona Cr. ab. *caeca* Cannav.[1]

Eritrea (Auriv. gives " Abyssinia ").

Glycestha aurota Fab.[1]

" Common everywhere."

Hodson. Males, 12. Females, 5. Locs. 17 (1927), 21 (26.iv, 30.xi), 23 (27–8.iv, 2, 4, 14.x), 25 (19.iv, 2.ix), 29 (24.iv), 45 (1927).

The specific name usually employed for this species is *mesentina* Cramer, but that name is invalid (see Hemming, 1932, *Trans. ent. Soc. Lond.* **80** : 283).

Ungemach found this species common all the year round and little variable. The darkest specimens greatly resemble *G. creona boguensis*; the distinctive character given by Aurivillius, derived from marginal spots, is of little use. A better character is the attachment of the black area at the end of the cell which in *boguensis* abuts directly on the costal margin without being prolonged along the subcostal nerve, whereas in *aurota* the area curves in towards this nerve and is prolonged along it almost to the base, although separated from the costal nerve by a white space.

---

[1] Placed by Aurivillius in *Belenois* Hübn., which he treated as a subgenus of *Pieris* Schrank.

Glycestha aurota Fab. f. aest. *lordaca* Walkr.[1]

Specimens in the British Museum from Banissa, Kindjo Djuna, Dalla Kaffa, Island of Zwai.

Belenois raffrayi Oberth.[2]

" German East Africa to Abyssinia."

Hodson. Males, 30. Females, 2. Locs. 34, 35, 41, 45 (1925), 51, 56 (7.ii), 61, 63 (1925).

Scott. Males, 2. Female, 1. Loc. Dj. 21–23.ix, 7–9.x.

Ungemach found it very characteristic of Western Abyssinia : towards the east it does not seem to pass Tchellea, but it occurs on the Baro.

Belenois zochalia galla Ung.[2]

Hodson. Males, 6. Locs. 27, 32 (18.i), 34, 39 (7.iii), 65 (13.xii).

This form is described by Ungemach as differing considerably from the type but approaching *agrippinides* Holl. Fore-wing in the male identical with that of *Glycestha creona boguensis* ; hind-wing with marginal triangles but no trace of submarginal line on upperside. Underside as type. The female is never bright yellow ; the posterior wing has a characteristic border like a row of Moorish arches. Common in central and eastern Abyssinia with the exception of the Baro country.

Belenois zochalia galla Ung. f. *depunctata* Ung.[2]

Hodson. Males, 2. Locs. 34, 39.

A very light form in which the male has only minute traces of marginal spots, and underneath a submarginal line in arches very faintly defined. The female has on the hind-wing no more than the marginal triangles of the male type of *galla*. This form is found in Wallega in May and June.

Belenois zochalia galla Ung. f. *agrippinides* Holl.[2]

There is a ♂ of this form in the British Museum (Natural History), taken on 8th of June at Nolé Kaba.

Belenois subeida zoraida Gaede.[2]

The distribution of this form is given in the " Lepidopterorum Catalogus " as " Cameroons, Sudan, Volta." There are specimens in the British Museum captured by Zaphiro in May 1904, at Abobo, on the Akobo river. This is the only record of *subeida* in Abyssinia.

Belenois calypso dentigera Btlr.[2]

Hodson. Males, 23. Females, 7. Locs. 8, 11, 12, 17, 18, 19 (21.x), 23 (2.x, 9.x), 29 (28.ix), 32 (21.i), 33, 34, 36, 38, 41, 44 (1925), 51 (3.ii.25), 60, 65 (13.xii.26), 69.

[1] Placed by Aurivillius in *Belenois* Hübn., which he treated as a subgenus of *Pieris* Schrank.

[2] Correctly placed by Aurivillius in *Belenois* Hübn., which, however, he treated as a subgenus of *Pieris* Schrank.

Ungemach found *calypso* very variable, with a local race and a winter form which from February to May are linked by transitions. Common in Wallega and on the Baro, but does not pass east of the Didessa. The form nearest *calypso* Drury is found on the Baro. All the Abyssinian females, of whatever form, have the basal half of the cell of the fore-wing coloured on the underside like the costa of the hind-wing: the extreme development of this he named *ochracea.* Hodson's collection contains one female of this form from loc. 36. Ungemach considered that the Abyssinian forms are nearest to race *welwitschi* Rogenh.

Belenois calypso dentigera Btlr. f. *hiemalis* Ung.[1]

Ungemach separated this form which occurs in Wallega from November to January by the great reduction of the yellow or black markings. Hodson took a male at loc. 32 (27.i.25).

Belenois calypso dentigera Btlr. f. *hailo* Ung.[1]

The subapical band beneath is brown and not black; the hind-wings rosy-ochre with bright orange longitudinal rays; the costa intensely red at the base. Several males in May at Nolé Kaba.

Belenois calypso sudanensis Talb.[1]

Recorded by Pagenstecher from " South Abyssinia."

Belenois thysa Hpff.[1]

" Congo, S. Africa, Somaliland."

Hodson. Males, 16. Females, 7. Locs. 2, 35 (1.ii), 36, 41, 42, 43 (10.ii), 45 (4.ii), 65 (3.ii, 15.ii, 3.iii, 10.xii, 1926).

These specimens on the whole have the spots lightly developed. Ungemach found this common in Wallega up to the Baro.

Belenois thysa Hpff. ♀ f. *tricolor* Ung.[1]

A female from Baro, May 30th, with which one captured by Hodson, loc. 45 (7.ii.27) agrees, seems to be a wet-season specimen.

Belenois solilucis Btlr.[1]

" Cameroons, Congo region, and Angola."

Hodson. Males, 13. Females, 3. Locs. 2, 3, 5, 19, 32 (21.i), 36, 51, 57.

One of the females is yellow-ochre, two are whitish. Ungemach found it plentiful in the forest at " Oumbi," but rare elsewhere in the west from the Baro to Billo.

The following female forms have been described.

B. s. appioides Ung. Described as having an extraordinary resemblance to *Appias yambo* (see *Dixeia dixeyi*).

B. s. hemichrysa Ung. Golden-yellow except in the anal space and the centre of area 2 towards the margin; base of the fore-wing pale orange; both wings with a rosy reflection beneath.

Dixeia dixeyi Neave.[2]

" Uganda."

Hodson. Males, 2. Female, 1. Locs. 5, 57 (2.ii).

---

[1] Correctly placed by Aurivillius in *Belenois* Hübn., which, however, he treated as a subgenus of *Pieris* Schrank.

[2] Placed by Aurivillius in *Pinacopteryx* Wallengren, which he treated as a subgenus of *Pieris* Schrank.

During 1934 the late Dr. F. A. Dixey when working out the Hodson Pierines said that Ungemach's illustration of *yambo* Ung. appeared to him to belong to the species *Dixeia dixeyi* Neave. In order that the point might be settled Mons. Ungemach very kindly sent over one of his specimens which Dr. Dixey diagnosed as a female *dixeyi*, rather larger than any specimens in the Hope Department. The name *Appias yambo* therefore falls as a synonym of *Dixeia dixeyi*.

This species was recorded by Ungemach under the name *Appias yambo* as being found in its typical form only at Yambo. At Youbdo, in Wallega, a female form was taken with less brown suffusion at the base and with the apical bands not lightened between the nerves. This plateau race, much smaller, he named *minuta*.

Dixeia saalmülleri Auriv.[1]

This is given by Aurivillius (1898, p. 414) as an Abyssinian record : in the opinion of Mr. G. Talbot (MS.) it is a form of *pigea*.

Dixeia orbona vidua Btlr.[1]

" British East Africa, Abyssinia, and Equatoria."

Hodson. Males, 5. Female, 1. Locs. 3, 23 (6, 8, 10.x).
Scott. Males, 2. Female, 1. Locs. Zw. (3–4.xi).
Bullock. Male, 1 ; Lake Langana, 8.i.25.

Ungemach found this common in the centre but not passing west of the Didessa. He distinguished the following three female forms :—

(1) *D. o. v.* f. *aurantium* Ung., " entièrement orange vif," from Goudder, Boché, Billo. The Hope collections contain a specimen of this form captured by Dr. A. Hayes (Poulton, 1905) at Lake Tana, 6500 ft., February 1903.

(2) *D. o. v.* f. *rubescens* Ung. " Correspond tout à fait à *pigea rubritincta*."

(3) *D. o. v.* f. *albida* Ung. With no trace of black on the posterior wing, corresponding to *pigea alba*.

Dixeia pigea Bdv.[1]

Hodson. Male, 1. Loc. 5.
Bullock. Female, 1. Loc. Mk.

Dixeia pigea Bdv. f. *alba* Wallengr.[1]

Hodson. Males, 13. Locs. 32 (1.ii), 34, 36, 39 (7.iii), 51 (3.ii, 23.ii), 57 (2.ii), 67.

Ungemach recorded *pigea* (s. l.) as very common westward from the Goudder but not found on the Baro or the Didessa. The male *pigea* has been captured *in copula* with females having " en dessous la tache rouge de la base de l'aile anterieur, considérée comme particulière à *rubrobasalis*." He considered that many specimens labelled *rubrobasalis* in collections are true *pigea*, and that the female *pigea* without the red beneath, does not exist in the parts traversed by him. The male forms *p. pigea* and *p. alba* appear to be neither seasonal nor geographical variations for both are found together from January to the end of June. The following forms of female are distinguished by the coloration, not by the comparative development of the black marks.

---

[1] Placed by Aurivillius in *Pinacopteryx* Wallengren, which he treated as a subgenus of *Pieris* Schrank.

Female forms.

(1) *D. p.* f. *vulgaris* Ung. has, on the underside, the basal patch of the front wing, the apex of the front wing, and the hind-wing wholly bright yellow to orange-yellow. Upperside " crême ocré."

(2) *D. p.* f. *nitida* Auriv. (described by Aurivillius, *in* Seitz, as a form of *rubrobasalis* from the Cameroons). Ungemach's Abyssinian specimens " sont exactement conformes au type d'Aurivillius."

(3) *D. p.* f. *rubritincta* Ung. Taken *in copula* with a typical male. Creamy white above, below as *vulgaris.* On the upper surface the cell and the lower third of area 1*b* are " largement teintés de rouge orange vif."

(4) *D. p.* f. *lathyi* Hulst. Bright yellow above and below. Basal spot on underside of fore-wing, red.

(5) *D. p.* f. *lutea* Ung. Like the last but with the same orange red spot above as in *rubritincta.*

(6) *D. p.* f. *lathyana* Strand.

The specimen from Abyssinia (no other data) to which Strand gave the name *elia* is, in Mr. Talbot's opinion, another ♀-form of *pigea* Boisduval.

Dixeia charina simana Hpff.[1]

Aurivillius treated this as the equivalent of *doxo* Godt. This widely spread butterfly is recorded by Pagenstecher (1902) from " Akaki, Hawasch, Maki, Abala-See " in Central Abyssinia.

Ungemach found *charina* localised to the eastern part of the Centre, between Addis-Alem and Tchellea. He pointed out that it can always be distinguished from *orbona* by the invariable presence of the disco-cellular point on the underside of the hind-wing, never absent in *charina.*

Dixeia charina liliana Sm., f. *gerda* Gr. Sm. and Kirby.

" German and British East Africa."

Aurivillius treated this as a distinct species. It is recorded by Strand from " Eli."

Dixeia doxo venata Btlr.

" White Nile."

Hodson. Males, 8. Female, 1. Locs. 3, 17 (26.x), 18, 19 (22.x).

These have the black markings on the underside not at all strongly marked; in a male from loc. 18 the black markings are only shown by dots at the ends of the veins.

Ungemach found *venata* abundant at Gambela, in geographical environment identical with that of the White Nile.

It is worth drawing attention here to a strong colony of this Nilotic species discovered by me in 1915 on the flat open plains to the west of L. Victoria, at about 1° 10′ S., 31° 30′ E., a few miles north of the Kagera river (*Proc. R. ent. Soc. Lond.*, Dec. 6th 1916). The specimens, nine males and six females, were captured in August, September and November. They are large and strongly marked with black, with a small orange flush at the base of the underside of the hind-wing anterior to vein 8. The species is discussed by Dixey (1918) and by Longstaff (1913, 1916). The form *voltaensis* described by Talbot (1929) from the Haute Volta is, I am informed by him, a synonym of *doxo doxo.* Talbot has figured *venata* in 1916, *Ann. Mag. nat. Hist.*, (8) **17**: pl. XII.

---

[1] Placed by Aurivillius in *Pinacopteryx* Wallengren, which he treated as a subgenus of *Pieris* Schrank.

The specimen from Abyssinia (no other data) to which Strand gave the name *abyssinibia*, is, in Mr. Talbot's opinion, only a ♀ of *venata* Butler.

Pontia daplidice aethiops Joannis & Verity.[1]

Hodson. Males, 3. Females, 2. Locs. 26 (31.iii.25), 36, 37, 44 (1925), 67.

Scott. Females, 2. Loc. B.

Ungemach found it very common from Somaliland to Wallega; not found on the Baro.

Pieris brassicoides brassicoides Guér.

" Only known from Abyssinia."

Hodson. Males, 8. Females, 8. Locs. 26, 37, 56 (19.ii). The fore-wing of one specimen bears a very characteristic imprint of a bird's beak.

Scott. Males, 2. Females, 5. Loc. A.A., Dj. (21–3.ix, 1–3.x).

Ungemach remarked that the ssp. *meridionalis* of Joicey and Talbot (1922) appears to be a simple form, for he has captured, in Abyssinia, specimens which agree with the description of the interesting form from Arusha district in Tanganyika Territory. He took on the same day at Addis Ababa the two extremes, showing the apical black patch on the fore-wing without any white, or with wide white interneural patches.

Hodson's specimens, as compared with those of Scott, show distinct differences, and in some respects agree with the type of *meridionalis*; they were taken in January, February, and April, while Scott's were dated September and October. The differences, which may be seasonal, seem to warrant a name being given to Hodson's forms.

Pieris brassicoides brassicoides Guér. f. **hodsoni** forma n.

Differs from *b. brassicoides* by the much greater development of the white interneural streaks on the fore-wing, in which it resembles *b. meridionalis*, but differs from the latter in the breadth of the black apical area which equals that of *b. brassicoides*: also the black veining on the underside of the hind-wing is more conspicuous in *b. meridionalis* than in *b. brassicoides* or its form *hodsoni*. The following is a detailed description. (See Plate X, figs. 16 and 17.)

Upper surface. Fore-wing. The apical black area is of the same width as in *b. brassicoides*, but the narrow white internervular streaks of the latter, which may only be just visible, or, as Ungemach points out, absent, are greatly expanded in this form so that they replace much of the black near the margin. This exaggeration is still greater in the female than in the male, so that the apex of the fore-wing may be very nearly white with black nervular streaks. *Hind-wing.* The triangular black spots on the margin at the ends of the veins are much smaller, so that in some cases they may be merely a slight thickening of the end of the vein: the marginal black line connecting them may be lacking in the middle between two veins, and is always feebly developed. *Under surface.* The veins are less heavily sealed with black than in *b. brassicoides* or *b. meridionalis.* On the hind-wing the internervular black streak in area 1*c* is barely thickened at its proximal, free, end, whereas in *b. brassicoides* there is a decided black spot there. Also, the area of black suffusion on the costa extending backwards across vein 7 to reach vein 6, forming an ill-defined spot is fainter than in *b. brassicoides.* The general coloration of the under surface is as in *b. brassicoides.*

Holotype, ♂. S.W. ABYSSINIA: Shoa Gimira Province, Tamanjayage, Jan. 28, 1925 (*Arnold Hodson*).

---

[1] Placed by Aurivillius in *Synchloë* Hübn., which he treated as a subgenus of *Pieris* Schrank.

Allotype ♀. S.W. ABYSSINIA: Mocha District, Ganji River, 5500 ft., Feb. 19, 1925 (*Arnold Hodson*).

Euchloë belemia abyssinica Riley.

" Abyssinia, Somaliland " (" Lep. Cat.").

Scott. The type female. Loc. C. (11.xi.26). (Riley, 1928.)

Colotis amatus calais Cr.[1]

" Congo, Angola, East Africa to Nubia and Bornu, South Arabia."

Pagenstecher gave many localities for it from Central Abyssinia (Suquala, L. Abaya, etc.).

Colotis phisadia ocellatus Btlr.[1]

" Somaliland."

Recorded by Pagenstecher from " South Abyssinia," but the locality is well south of the highlands (41° 30′ E., 5° 30′ S.). This species therefore does not fall into the category of Abyssinian species as defined in this paper.

Colotis vestalis castalis Stgr.[1]

" British East Africa and Somaliland."

Also recorded by Pagenstecher from " Wondu " (= Woondo, east of L. Awusa).

Colotis gaudens Btlr.[1]

" Abyssinia and Arabia."

The original claim of this species to be included in an Abyssinian list does not bear investigation: it depends upon Butler (1876), whose " Abyssinian " specimen came from " Atbara," which is in the south Sudan. However, it has been recorded by Le Cerf (1924c) under the form *arenicolens* Btlr. from Nefasit, at 1600 metres, in Eritrea.

Colotis chrysonome Klug.[1]

" German East Africa to Somaliland, Nubia, Bornu, and Arabia."

Hodson. Male, 1. Loc. 25.

Colotis vesta Reiche.[1]

" Abyssinia, but quite similar specimens occur also in South Africa."

Hodson. Males, 4. Females, 5. Locs. 21 (30.ix), 22, 25 (29.iv), 29 (24.iv).

Bullock. One male. Loc. H.R.

Colotis amelia velleda Luc.[1]

Lucas in his description (1852, *Rev. zool.*, (4) **2**: 428) merely gives " Abyssinia " for the locality. Butler (1876) refers to " *Teracolus amelia*," but his reference is cited by Talbot in the " Lep. Cat." under *C. amelia velleda*: the locality is Atbara, not Abyssinia. Aurivillius (1898) doubted Lucas' *velleda* as more probably *vesta*; but Talbot (1929) stated that *velleda* " is a distinctly defined race of *amelia* and does not belong to *vesta*." Thus the claim of *velleda* to an Abyssinian record rests upon the vague locality given by Lucas.

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Colotis protomedia Klug.[1]

"German and British East Africa, Somaliland, Abyssinia, Nubia, and westwards at least to Yola in Niger region."

Hodson. Males, 4. Females, 6. Locs. 20, 21 (25.iv), 22, 23 (28.iv, 6.x), 25 (29.iv).

Ungemach found it common on the Baro, in May.

Colotis celimene Luc.[1]

"South and East Africa to Abyssinia."

Colotis venosus Stgr.[1]

"British East Africa."

Recorded by Pagenstecher from the edge of the highlands, very near Karijalu *circa* 40° 45′ E. and 6° 45′ N.

Colotis halimede acaste Klug.[1]

"German and British East Africa, Somaliland to Nubia and thence to Senegal."

Hodson. Female, 1. Loc. 21.

Colotis halimede acaste Klug f. *aurivillii* Rthsch.[1]

Suakim, Abyssinia, British East Africa.

This is the wet-season form.

Colotis pleione heliocaustus Btlr.[1]

"Somaliland."

This has been taken at Sheik Hussein in the Arusa Galla country by Gillet (Butler, 1897B).

Colotis eris Klug.[1]

"German East Africa to Somaliland, Abyssinia, Nubia, thence to Senegal."

Hodson. Females, 2. Locs. 22, 29 (Sept.).

Female form *abyssinicus* Btlr.

Butler's locality is Atbara, in the Sudan, although he alluded to it as in Abyssinia. No other records than this are given in the "Lep. Cat."

♀ f. *erioides* Strand. Abyssinia is the locality given, without data.

Dry ♀ f. *fatma* Feld. Recorded by Pagenstecher from the Arusi Galla country.

Colotis ione God., f. *phlegyas* Btlr. and f. *jalone* Btlr.[1]

"From Natal through East Africa to Abyssinia and Nubia, also in South West Africa."

Hodson. Males, 12. Females, 13. Locs. 16, 20, 23 (28.iv, 5–6.x, 13.x, 1925), 25, 62.

Both forms occur from each locality, and there are transitional specimens. The extreme form *jalone* with orange tips in the female was taken at locs. 16 and 22 in October.

Ungemach only met this species "dans les environs de Diré-Daoua, en Somalie, en juillet."

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Colotis bacchus Btlr.[1]

" East Africa to Equatoria."

Ungemach found this " spéciale au Baro, où elle est peu commune." One female is only a little less black than the form *anomalus* Auriv.

Colotis lorti E. Sharpe.[1]

Hodson. Males, 9. Females, 18. Locs. 20, 21 (April, Sept.), 22, 23 (1–3, 10–11.x), 29 (April, Sept.).

Bullock. Male, 1. Loc. L.

Ungemach described as *Teracolus hetaera aspasia* specimens in which in the male " les dessins sont extrêmement réduits " and, in the female, " beaucoup moins chargée de noir." The male has the nervures mostly white, and the marginal spots absent or very little developed. " La nervure 4 est incluse dans la tache ornamentale sur tout son dernier tiers." The female has no trace of red at the apex : underneath, the posterior wings and the apex of the anterior wing vary from pale yellow to pale rosy orange. It seems probable that the Abyssinian specimens link *hetaera* with *lorti*, and that both are forms of one species. In Hodson's series while the size of the ornamental spot is as in *hetaera*, the colour tends to be intermediate between the rather brick-red of *hetaera* and the more purple-red of *lorti*. Ungemach's specimens appear to have the wider ornamental spot of *lorti*.

Some of Hodson's females are without a trace of red at the apex, in others there are two rows of red spots separated by black dots. Five of them are of the sulphur-yellow aberration.

Colotis puniceus Btlr.[1]

" East Africa to Equatoria."

There are four females of this species in the Tring Museum, captured by Neumann on the Omo river.

Colotis eupompe Klug,[1] and its form *pseudacaste* Btlr.[1]

" East Africa, Somaliland, Equatoria, Abyssinia, Arabia, and along the southern boundary of the Sahara to the Senegal."

Hodson. Males, 10. Females, 10. Locs. 11, 20, 21 (25–26.iv., 30.ix), 22, 23 (28.iv, 2.x, 10.x), 25, 62.

The so-called wet- and dry-season forms are well represented, with transitionals; both occur in March, April, and October. The September specimens are dry.

Scott. Three males and one female from Loc. D. (29.xii.26).

Bullock. One male and one female from Loc. H.R.

Ungemach found the species " en Somalie et sur le Baro, aux deux extremités du domaine." The form *eupompe* is commonest in the east, and *pseudacaste* in the west, but these are neither geographical nor seasonal. The following forms have been described :—

C. eupompe ab. *pallidus* Ung. Thoracic hairs white, whereas the normal are grey, and all the markings normally black are pale grey.

C. eupompe, ♀ f. *depurpurata* Ung. No trace of red at the apex, which is black except for wedge-shaped white streaks in areas 4–8.

C. eupompe, ♀ f. *pulchra* Ung. Is mostly yellow.

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Colotis antevippe Bdv.[1]

Hodson. Males, 5. Females, 6. Locs. 14, 16, 18, 19, 22, 23 (April), 29 (April).

Scott. Male, 1. Loc. Z.W. (5–7.xi.26).

Bullock. Males, 3. Loc. H.R.

Ungemach found this abundant on the Baro, and more rarely on the Didessa: male constant, female very variable.

This species is usually known as *Colotis achine* Stoll, but, as Hemming (1934, *Gen. Names holarct. Butt.* **1**: 135) has pointed out, that name is an invalid homonym.

Colotis antevippe Bdv. f. *simplex* Btlr.[1]

Hodson. Male, 1. Female, 1. Locs. 21 (April), 56 (19.ii).

This is the dry-season form.

Colotis evippe L.[1]

" The only species of *Teracolus* [i.e. *Colotis*] which is indigenous to the forest region of West Africa." "Lep. Cat." gives "Sierra Leone to Angola, Haute Volta to S.E. Sudan, Abyssinia, N. Congo, Cameroons."

Hodson. Males, 4. Females, 4. Locs. 3, 25 (April), 36, 57, 65 (16.xii), 69.

One male and one female are of the typical form, heavily marked with black: the remainder are of the dry-season form with scarcely any black border to the orange posteriorly (= *epigone* Feld.).

Ungemach wrote of *microcala* Btlr. under the mistaken name of *omphale*. Butler himself (1876) put it next to *epigone* Feld. and Aurivillius (1898) sank both under *evippe*. Ungemach wrote of *microcala*, which he found on the Baro, in May, as a small form which he could not distinguish from *pallene* Hpff.

Colotis omphale Godt.[1]

" The species occurs in the whole of South Africa to Angola, and the southern parts of the Congo State; in East Africa, Abyssinia, Arabia, Senegambia."

Ungemach found that, except for one male *antigone*, *omphale* is the only *Colotis* in Abyssinia proper: it occurs not only in the tropical region around Abyssinia proper, but in the very centre of it, and in Wallega. The typical *omphale* occurs only in the tropical zone, on the Baro, rarely.

Colotis omphale God. f. *omphaloides* Btlr.[1]

The predominant form in the centre from April to June, and in Wallega in November.

Colotis omphale God. f. *theogone* Bdv.[1]

The commonest form on the Baro.

Colotis omphale God. f. *pyrrhopterus* Btlr.[1]

Ungemach found a form near to this in Abyssinia proper, in January–February. He wrote that it is not possible to disentangle as seasonal or geographical races the various forms of *omphale* in Abyssinia.

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Colotis pallene Hpff.[1]

"Namaqualand, Matabeleland, Zambezi, Nyasaland." Talbot in the "Lep. Cat." adds Tanganyika Territory.

Ungemach took an undoubted male of this essentially southern species on the Didessa in February. He thought specimens of *microcala* Btlr. (which he mistakenly assigns to *omphale*) may often be *pallene*; that is, specimens having on either side of the hind-wing no trace of black outside the small isolated marginal spots.

Colotis daira Klug.[1]

The literature on this subject is very confusing, and cannot be treated here at any length. Dr. F. A. Dixey considered *evagore* Klug, and *antigone* Bdv., as one species, separating them from *daira*. He considered that too much stress should not be laid upon Butler's statement (1897 : 460) that *evagore* and *yerburii* were reared from one batch of larvae, as there is no evidence that these larvae came from one batch of ova: in his opinion the larvae of *evagore* and *daira* are distinct. Reference should be made to Dixey (1903 : 160–2) and Longstaff (1913 : 41–3). The specimens now cited have been identified by Dixey whose arrangement is followed for *daira* and *evagore*.

Hodson. Males, 8. Females, 16. Locs. 17 (March and October), 18, 20, 21 (25.iv, 30.ix), 22, 23 (3–10.ix), 29 (23.iv).

Dixey wrote of these: "The females are of the African form which does not occur in Arabia (f. *yerburii* Swinh., is the Arabian form. Klug's female type is African, though he gives 'Arabia Felix' as the type locality)."

Colotis evagore Klug.[1]

"British East Africa, Somaliland, Abyssinia, Nubia, Arabia."

Hodson. Males, 18. Females, 8. Locs. 17 (12.iii), 18, 19, 21 (April), 23 (28.iv), 25 (2, 8, 14.x), 62.

Scott. Males, 4. Locs. Zw., M.

Bullock. Males, 2. Loc. H.R.

Ungemach wrote, under the species *daira*, that he took males of the form *evagore* Klug, in the east on the Modjo, and at Moullou, in February; and in July at Dire-Daoua.

C. antigone phlegetonia Bdv., according to Dixey, comes under *evagore*. Ungemach found this very variable butterfly common on the Baro and rare in the east. All transitions occur in the male between the type and ab. *xanthus* of Swinhoe. A series of the form *emini* Btlr., was captured on the Baro.

Colotis evenina Wallengr.[1]

"The species is distributed from Cape Colony to S. Angola and Somaliland."

Pagenstecher (1902) recorded this form from south Abyssinia.

This species must be rare in Abyssinia: it is not mentioned by Ungemach.

Colotis evenina Wallengr. f. *sipylus* Swinh.[1]

Reported by Butler (1897) from the Arussi Galla country.

Colotis evenina Wallengr. f. *casta* Gerst.[1]

Hodson took a single small pale female in loc. 25, in April.

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Colotis agoye zephyrus Marsh.[1]

" Somaliland."

This Somaliland form of a southern species was taken by Pagenstecher at about 6° N., 41° E., at the 1500 metre contour and may be considered as just reaching the country under survey.

Colotis evarne Klug.

Hodson. Males, 11. Females, 6. Locs. 4, 16, 17, 21 (April), 22, 23 (April, Oct.), 29, 62.

Scott. Male, 1. Loc. Zw.

Bullock. Males, 3. Female, 1. Loc. H.R.

Ungemach found this common on the Baro, and also specimens approaching the form *sharpei* Auriv.

Colotis evarne Klug f. *philippsi* Btlr.

Ungemach reports this from Dire-Dawa. His records of *auxo* Luc. must be deleted.

Dr. F. A. Dixey having queried the record, M. Ungemach kindly sent a specimen on which Dr. Dixey reported as follows : " *C. auxo* Luc. was described from Natal. It is not known from further north than N.E. Rhodesia. I have never found plume-scales in the males of *C. auxo* or of its E. African representative, *C. incretus* Butl. The male of *C. evarne* Klug possesses them and they are present in Ungemach's specimen. I have no doubt whatever that this is *evarne*. It was caught at the change of seasons, and the *evarne* recognised as such by Ungemach may have been the other seasonal form."

Under other species will be found notes by Ungemach on the two " seasonal forms " flying together.

Eronia cleodora Hbn.

" South Africa to Angola and the whole of East Africa to Abyssinia."

Hodson. Males, 2. Females, 3. Locs. 21, 23 (3, 10, 11.x).

Eronia leda Bdv.

" Kaffirland to Abyssinia."

Hodson. Males, 4. Female, 1. Locs. 18, 21 (Sept.), 23 (5.x), 51.

Scott. Males, 2. Loc. Zw. (3–4.xi.26).

Bullock. Males, 2. Loc. Mk.

Ungemach found it widespread in the west, rarer in the centre.

Eronia leda Bdv. f. *cygnophila* Suff.

Reported from " Eli " by Strand.

Eronia leda Bdv. ab. *pupillata* Strand.

Reported from " Marocko (Ab.) am Flusse," by Strand.

Eronia thalassina Bdv.

" From the Senegal to the Zambezi and British East Africa."

Hodson. Males, 10. Females, 2. Locs. 5, 8, 19, 45 (7.ii), 51 (23.ii), 54 (1927), 56 (7.ii), 59 (1927).

---

[1] Placed by Aurivillius in the genus *Teracolus* Swainson.

Scott. Male, 1. Dj. (1–3.x.26).

Ungemach found it common near watercourses from Baro to Goudder.

Eronia buqueti arabica Hpff.

" South Africa to Angola, the whole of East Africa, on the Senegal, in South Africa, and on Madagascar: but is wanting in the West African forest region."

Two males of this dry-season form in the British Museum were taken by Degen at " Dhar Allar " 25 January, 1902.

Catopsilia florella F.

Universal.

Hodson. Males, 7. Females, 4. Locs. 7, 8, 19, 26 (8.ix), 29 (March), 31, 34, 51, 65 (16.xii), 66.

The females, captured from October to December, are of the yellow form.

Ungemach found it very common everywhere.

Catopsilia florella F. ♀ f. *pyrene* Swains.

Ungemach found this pale female commoner than the yellow.

Terias hecabe senegalensis Bdv.

Universal.

Hodson. Males, 3. Female, 1. Locs. 12, 14, 23 (6.x, 9.x).

Scott. Males, 2. Loc. D. (18–20.x.26).

Bullock. Males, 3. Loc. L.

Terias hecabe senegalensis Bdv. f. *bisinuata* Btlr.

Hodson. Males, 18. Locs. 14, 27, 29 (16.iii), 32 (21.i), 33, 34, 35, 38, 45 (4.ii), 47, 65 (22.xii).

Ungemach found the wet-season form *bisinuata* " dans la partie demi-soudanaise du domaine."

Terias hecabe senegalensis Bdv. f. *brenda* Dbl.

" The whole West African forest region to Uganda and in Portuguese East Africa."

Ungemach found this form common between the Didessa and the Baro: also at Dire-Dawa in the east.

Terias hecabe senegalensis Bdv. f. *maculata* Auriv.

Flies with the *brenda*: Ungemach did not find it to be a seasonal form.

Terias hapale Mab.

" West and East Africa and on Madagascar."

Hodson. 21 specimens: very difficult to separate males from females, as this species has no brand in the male. Locs. 24, 26 (10.ix), 28, 32 (24.ix.24, 18.i, 20–22.i.25), 34, 35, 37, 45 (4.ii).

Ungemach found it from the Baro to the western end of the Somali territory.

According to Corbett (1934, *Entomologist*, **67**: 277–279) *hapale* has male genitalia distinct from those of any other African species: it is only found in Africa, but is probably derived from the eastern *andersoni*.

Terias desjardinsi Bdv.

The species is almost universal.

Hodson. Males, 27. Females, 5.

Scott. Males, 8. Females, 4. Locs. A, C., Dj., Dj–A.

Ungemach. Common in the whole of Wallega.

Hodson's specimens taken in September come near the extreme "wet" form *regularis* Btlr. January specimens are nearer the "dry" form *marshalli* Btlr.

Terias desjardinsi Bdv. f. *marshalli* Btlr.

Ungemach recorded this dry-season form from the centre, as well as in Wallega, from February to May.

Terias desjardinsi Bdv. ♀ f. *aliena* Btlr.

Recorded from Tchellea by Ungemach.

Terias brigitta Cr.

Hodson. Males, 5. Females, 10. Locs. 14, 21 (25.iv), 23 (2–5, 8–9.x), 26 (10.ix, 21.ix), 28, 35.

Scott. Males, 4. Locs. D., Zw.

Bullock. Males, 8. Females, 2. Locs. H., L.

Ungemach found it extremely common in the centre: also taken in Wallega.

Terias brigitta Cram. f. *zoë* Hpff.

Females taken by Ungemach in June belong to this wet-season form.

Colias marnoana Rogenh.

Ungemach took this species which, following Aurivillius, he wrongly referred to as *Colias hyale sareptensis* Stgr., on the steppes in the eastern part of Wallega in January and February. He particularly noted the rapid flight of this insect. One example had an expanse of 57 mm.; the rest were of the size of European examples of *Colias hyale* L.

Butler (1898) recorded *marnoana* (under its correct name) from the "Harrar Highlands." Aurivillius recorded it "from the Soudan" as a form of *hyale*, and wrote of *hyale* "This European species occurs in Abyssinia in a form which is very similar to *sareptensis* Stgr."

Colias electo L.

"Typical form only occurs in S. Africa. Specimens from the Cameroons and East Africa are larger and scarcely distinguishable from *croceus* Geoffr."

Hodson. Males, 5. Females, 8. Locs. 26 (31.iii, 2–5.iv, 20.ix), 32 (22.i), 35, 37, 65 (24–27.xii).

Scott. Females, 24. Locs. AA., C., Dj., Dj–A., Z.

Colias electo L. ♀ f. *aurivillius* Kef.

Hodson. 6. Loc. 26 (31.iii, 2–5.iv, 20.ix).

Ungemach took this "plusieurs fois dans le Centre, en avril et en juin."

Colias electo L. ab. *kostlani* Strand.

From "Eli."

DANAIDAE.

Danaus chrysippus L.[1]

Hodson. Males, 4. Females, 3. Locs. 11, 17, 18, 22, 29 (28.ix), 35, 65 (23.xii.26).

Scott. Male, 1. Loc. Zw. (29.x.26).

Bullock. Males, 4. Locs. Mk., H.B.

Danaus chrysippus L. f. *alcippus* Cr.[1]

Hodson, transitions from *chrysippus* to *alcippus*, males, 6. Typical *alcippus*, males, 12, females, 2. Locs. 6, 11, 20, 22, 23 (4, 6, 11.x), 35, 38, 44 (1927), 54 (1927), 61, 68.

Danaus chrysippus L. f. *dorippus* Klug.[1]

Hodson. Males, 10. Females, 3. Locs. 18, 22, 23 (8.x), 25, 34, 65 (20.xii.26).

Bullock. Male, 1. Female, 1. Loc. H.B.

Danaus chrysippus L. f. *albinus* Lanz.[1]

Hodson. Males, 4. Female, 1. Locs. 11, 14, 23 (8.x), 25, 35.

I cannot follow Aurivillius in keeping *chrysippus* and *dorippus* distinct species, and Ungemach also took this view. He wrote of the species " Ces deux (?) espèces sont répandues dans tout le domaine, et communes dans l'Ouest sous toutes leurs formes." Poulton (1905) found that a specimen from Lake Tsana (considerably north of the localities given above) had the paler tint " characteristic of Oriental specimens."

Danaus petiverana Dbl.[1]

" Common everywhere in the African tropics."

Hodson. Males, 8. Female, 1. Locs. 11, 22, 36, 44 (1927), 45, 51 (3 and 23.ii).

Scott. Male, 1. Bed of Hawash river, near Mt. Zuquala, 6000 ft., 29.x.1926.

Ungemach found it common enough between the Didessa and the Baro, but apparently absent in the centre. He found in them no differences from Congo specimens. It is, in my experience, a very stable species.

Danaus formosa neumanni Rthsch.[1]

" Abyssinia."

Hodson. Males, 39. Females, 4. Locs. 32 (22.i.25), 39, 54, 55, 56 (7 and 19.ii.25), 58, 59, 61, 63, 65.

Ungemach found it very common in Wallega. The base of the anterior wing may be darker than in the type : in one example the cell is almost black and area 1*b* a very dark brown.

Amauris niavius aethiops R. & J.

" Abyssinia."

Hodson's specimens are slightly transitional to *niavius* of other parts of Africa ; they may be tabulated as follows :—

---

[1] Placed by Aurivillius in the genus *Danaida* Latreille.

♂ Specimen No.	Locality.	Anterior spot free.	Anterior spot enclosed.	Base of area 3 in H.W. only partly white.	Base of area 3 in H.W. broadly white.
1	34		+		+
2	19	+		+	
3	65		+	+	
4	,,	+			+
5	,,	+			+
6	63	+			+
7	61	Intermediate		Intermediate	
8	59	+			+
9	,,	+			+
10	45		+	+	
11	43		+	+	
12	44		+	+	
13	42	+			+
14	4		+	+	
15	,,		+		+
16	,,		+		+
17	,,		+		+
18	5		+	+	
♀	42	+			+
19		8	10	7	11
Didinga specimens		4	15	(no white), 6 7	5

The transition to *aethiops* is shown in the narrowing of the main white subapical patch of the fore-wing and its recession from the submarginal white dots in area 3 which in typical *aethiops* are quite free, whereas in ten of Hodson's nineteen specimens the anterior of these spots is enclosed in the end of the subapical patch. In Hodson's specimens, also, the broad black marginal band of the hind-wing never completely covers the base of area 3, which is always partly white. The series of specimens from the Didinga Mts., S.E. Sudan, described by me (1928) are here tabulated after re-examination as well as the Abyssinian examples, for comparison : they show a greater proportion with the " anterior spot enclosed," and in nearly one-third the hind-wing black border completely fills the base of area 3.

It will be noted that Hodson's examples support Ungemach's statement that the cell of the hind-wing is never blackened at the extremity, that is to say, that in these Abyssinian specimens the white area of the hind-wing is somewhat larger than in typically West African *n. niavius.* Ungemach in a footnote disagreed with the comment by Rothschild and Jordan on Pagenstecher's account of a specimen from " Gerwidscha " (R. & J., 1903 : 496–7).

Amauris ochleides darius R. & J.

" South Abyssinia."

Hodson. Males, 22. Females, 2. Locs. 19, 22, 23 (3.x.25), 44, 45 (1927), 63 (1927), 65 (1926–27).

Ungemach found this very common in Wallega up to the Didessa.

Hodson's specimens agree with the remarks of Rothschild and Jordan (1903) on the variability of the two subapical dots of the fore-wing and the number of the submarginal dots on the upperside of the hind-wing.

Besides these, there is a male and a female from locs. 22 and 23 which approach the Comoro form *affinis* Auriv. in having the spot in area 2 of the fore-wing produced pointedly to fill the base of the cell.

Amauris hecate stictica R. & J.

" Abyssinia."

Hodson. Males, 18. Females, 6. Locs. 44 (1927), 61, 65 (11–28.xii.26, 13–14.i.27).

Ungemach recorded this as much less abundant than *darius* or *steckeri*.

Amauris echeria steckeri Kheil.

" Abyssinia."

Hodson. Males, 38. Females, 2. Locs. 32 (18–21.i), 35 (25.i), 37, 53, 56 (7.ii.25), 60, 64 (11.i.27), 65 (9–14, 18–29.xii.26, 1.i, 14.i.27).

Bullock. Males, 2. Loc. L.

Ungemach wrote of this as extremely abundant in the wooded country of Wallega, less so in the centre. It often appeared in swarms.

Amauris lobengula abessinica Schmidt.

Eritrea (Asmara).

This extremely interesting form described by Schmidt (1921) was not known to me when (1928) I described *A. lobengula mongallensis*. Attempts to trace the type of *abessinica* have failed and it has not been possible to compare it with the type of *mongallensis*. The description, however, leaves little doubt that they are the same, and *mongallensis* must fall. Schmidt does not mention the large spot in the cell of the fore-wing which is, in *mongallensis*, of a characteristic shape. Both Schmidt and myself had described this northern race as having its nearest ally in the southern *katangae* Neave.

SATYRIDAE.

Melanitis leda africana Fruhst.

Universal.

Hodson. Males, 9. Females, 3. Locs. 2, 7, 11, 14, 16, 18, 19, 36.

Ungemach only met the " typical form " once, at Gotha (" Somalie "), in July, in mid dry-season, although it is the wet-season form. In the west, where he only collected in the wet season, only the form *ismene* Cr. was captured.

Melanitis libya Dist.

" Senegal, Nyasaland, Manicaland, German East Africa, Uganda."

Hodson. Males, 6. Female, 1. Locs. 9, 13, 14.

Ungemach. Not very abundant : found here and there in Wallega and the centre : quite common at Youbdo in December.

Gnophodes parmeno parmeno Westw.

" West African forest region from Sierra Leone to Angola and Uganda."

Hodson. Males, 3. Females, 2. Locs. 5, 11, 14.

Gnophodes parmeno diversa Btlr.

" Natal to British East Africa."

Ungemach found this eastern race exclusively at Youbdo, abundantly. He did not record the western race, which Hodson took.

Mycalesis sandace Hew.

" Senegal to the Congo."

Hodson. Males, 17. Female, 1. Locs. 34, 39 (18.ii), 56 (19.ii), 64 (7.i), 65 (9–23.xii).

Mycalesis mollitia Karsch.

" Only known from the Congo, from Ruwenzori and Uganda."

Hodson. Male, 1. Loc. 51 (3.ii).

Mycalesis campa Karsch.

" Togo."

Hodson. Males, 2. Loc. 17 (Oct.).

Mycalesis milyas Hew.

" From Togo to the Congo, the White Nile and Abyssinia."

Hodson. Males, 6. Females, 5. Locs. 9, 16, 17 (Oct.), 18, 68.

Ungemach recorded one female; a rare species, only found on the Baro.

Mycalesis pavonis Btlr.

" From Adamana [*sic*] to Abyssinia."

Mycalesis desolata desolata Btlr.

" Sierra Leone to Angola and Abyssinia."

According to the arrangement in the British Museum this is the same as *milyas* Hew.

Mycalesis desolata selousi Trim.

" Mashonaland and German East Africa."

Ungemach took a single female at Lilmo, between Gambela and Dambidollo, which was identified by comparison with the type in the Joicey collection. This form Aurivillius considered to be a *southern* race.

Mycalesis safitza aethiops R. & J.

" South Abyssinia."

Hodson. Males, 53. Females, 25. Locs. 14, 17, 18, 19, 23 (6.x), 26 (8–15.ix), 32 (21–2.i), 34, 35 (25.i), 36, 39 (18.ii), 40 (10.iii), 43 (1925, 1927), 44 (1925), 51 (3.ii, 23.ii), 53, 57 (9.ii), 60, 63, 64 (9.i), 65 (7–31.xii.26, 3.i, 13.i.27), 66. The species ranges from 2000 to 6500 ft.

Ungemach found this extraordinarily abundant in the west and west centre. He considered *aethiops* a species distinct from *safitza*, on account of the characteristic course taken by the median line on the underside of the wings. He pointed out that the type of *aethiops* is apparently the wet-season form, and described the dry-season form under a new name.

Mycalesis safitza aethiops R. & J. f. *velutina* Ung.

The upperside of the fore-wing has a yellow area perpendicular to the costa, midway between the end of the cell and the ocellus in area 5. Beneath, the contrast between basal and marginal areas is violent: the ocelli are more or less vestigial except that of area 2 on the fore-wing which is exactly like that of *aethiops* type. In the female the underside presents less contrast. Captured at Youbdo in December–January.

Mycalesis anynana Btlr.

" German and British East Africa."

Hodson. Male, 1. Loc. 19.

Mycalesis vulgaris Btlr.

" Sierra Leone to Angola and Uganda."

Hodson. Males, 7. Females, 4. Locs. 6, 11, 14, 19, 32, 36, 64 (15.ii.25).

Ungemach found this dry-season form very common between Didessa and Guibbé, but scarcely occurring in Wallega.

Mycalesis vulgaris Btlr. f. *tolosa* Plötz.

Hodson. Male, 1. Females, 2. Locs. 11, 14, 15.

These wet-season specimens are all from low elevations.

Mycalesis angulosa Btlr.

Angola to Sierra Leone, Uganda, South Abyssinia, Sudan, Kigoma (Tanganyika).

The British Museum possesses a male and a female captured by Zaphiro at " Kog " (? Gok) on the upper Gila river, 10.v.04; this is below the 1500 metre contour. Also a male by the same captor from " Lima " (? Limu) above the upper Didessa river.

Mycalesis funebris nebulosa Fldr.

" Sierra Leone to Uganda."

Hodson. Males, 6. Females, 2. Locs. 4, 11, 14, 19.

Mycalesis funebris orientis Ung.

" Sur le Djaoué (Baro)."

Differs from typical *funebris* by the uniformly blackish-brown upper surface without eye-spots, only lighter at the apex. On the underside the median line runs the same course as in *aethiops*, but there is little difference in tint between the proximal and distal areas. Ocelli well developed except in area 4 (? of fore-wing). The long, black brush and short white one are as in *funebris funebris*. Two males were taken.

Henotesia perspicua Trim.

"From the Congo to Natal, and from there to British East Africa and Abyssinia."

Hodson. Males, 10. Females, 3. Locs. 11, 14, 15, 19, 23 (9.x), 26 (15.ix), 48.

Ungemach found it widely spread, from the Goudder to the Bouré, but never abundant.

Henotesia perspicua Trim. f. *maevius* Stgr.

Hodson. Males, 2. Locs. 12, 39.

This dry-season form was found by Ungemach in Wallega in January, and again April–May.

Pararge maderakal Guér.

" Abyssinia and Northern Somaliland."

Ypthima asterope Klug.

Hodson. Males 8, Females, 4. Locs. 1, 16, 17, 18, 23 (2, 7, 12.x), 25 (29.iv.25). Two males and the females are of the dry-season form with ocelli little developed.

Scott. Females, 2 (dry-season form). Locs. Zq., Zw.

Ypthima asterope Klug ab. *simplici-ocellata* Strand.

"Abyssinia."

Ungemach recorded this aberration as common in Somaliland, rarer in the centre and on the Baro. In the east the ground-colour is grey, in the centre brown; in the latter area the darker lines are less conspicuous.

Ypthima simplicia Btlr.

"Congo, East Africa, Abyssinia."

Hodson. Males, 2. Locs. 17, 23 (10.x).

Ungemach found this only on the Baro, where it is rare.

Ypthima doleta Kirby.

"West Africa from Sierra Leone to Angola."

According to E. M. Sharpe (1896) this species was taken by Donaldson Smith at Sheik Hussein, in the Gillett Mountains.

Ypthima impura Elw. & Edw.

"Gaboon, Angola, and East Africa."

Hodson. Males, 7. Females, 7. Locs. 11, 16, 17, 19, 26 (15.x), 39 (7.iii), 65 (27.xii).

Ypthima pupillaris paupera Ung.

Wallega and Didessa.

Ungemach found this species common in the west in two distinct seasonal forms. The race *paupera* differs by the constant absence from the upperside of the double ocellus in area 1*c* on the hind-wing: underside as in nominotypical *pupillaris*.

Ypthima pupillaris paupera Ung. f. *hiemis* Ung.

Youbdo.

Identical with *paupera* above: under surface of hind-wing differs by the very small black ocelli: there is a transverse submedian area of darker tint sharply limited by a sub-basal and a median, undulating, dark-brown line. Taken in January.

Ypthima itonia Hew.

"Sierra Leone to Angola, Manicaland, German East Africa and Abyssinia."

Hodson. Males, 38. Locs. 24, 26 (31.iii, 8.ix, 20–1.ix), 32 (18–27.i), 37, 39 (7.iii), 60, 65 (13–28.xii).

These localities seem to indicate that *itonia* does not occur at the lower levels.

Ungemach found it widely distributed, except on the Baro. He recorded it under the minor aberrations *hochneli* Holl. and *micro-ocellata* Strand.

NYMPHALIDAE.

Euxanthe eurinome birbirica Ung.

E. eurinome occurs from Sierra Leone to the Niger as race *eurinome* Cr., and from the Cameroons to Angola and Unyoro as race *ansellica* Btlr. Ungemach's form approaches *ansellica* in the reduction of the basal pale area of the hind-wing and the irregular submarginal spots on the anterior wing. But the submarginal spots of the posterior wing are of the size of those of *eurinome*. All the pale spots of the anterior wing much smaller than in the known races. The female has the base of the hind-wing red-brown instead of black: the outer part of area 1*b* is the same brown but pale. Three males and a female captured at Youbdo; all, except one male, at fermenting sap of an injured tree.

Charaxes jasius epijasius Reiche.

"South of the Sahara from Senegambia to the Nile, in Unyoro and Abyssinia."

Hodson. Males, 5. Loc. 23 (3, 5, 7, 12.x).

Ungemach found it only on the Baro and the Didessa.

The blue tint in four of Hodson's males is of the usual greenish-blue, but in one male the green is less apparent.

Charaxes brutus somalicus Rthsch.

"Somaliland."

Hodson. Males, 17. Locs. 32 (24.ix), 34, 41, 45, 53, 54 (1927), 56 (7.ii, 19.ii.25, 26–7.i.27), 63 (1927).

Charaxes brutus junius Oberth.

"Abyssinia."

Ungemach's specimens are recorded as this form, only differing from the other by a somewhat wider median band. He found *brutus* one of the less rare species; in Wallega, and at Youbdo.

Charaxes castor Cr., ab. *godarti* Auriv.

"Senegambia to the Congo and Uganda."

Hodson. Males, 4. Locs. 3, 7, 13, 23 (14.x).

Ungemach took three males at Youbdo, one on the Indina.

Three of Hodson's specimens have both hind-wings injured, large pieces being missing from the hind margin, suggesting the attack of an enemy.

Charaxes pelias pagenstecheri Schultze.

A specimen in the British Museum was captured on the "Katar R. [? Katter, L. Zwai], Abyssinia" by Zaphiro 1905.

Charaxes hansali Fldr.

"Abyssinia and Somaliland."

Charaxes phoebus Btlr.

"Abyssinia."

Ungemach took numbers on a diseased tree at Youbdo.

Charaxes etesipe abyssinicus Rthsch.

"Abyssinia."

Hodson. Males, 6. Locs. 32 (18.1, 24.ix), 53, 56 (27.i), 65 (3.i.27).

One specimen has the hind margin of the left hind-wing mutilated, with a scratch on the front wing leading from the injury: it suggests the work of a bird. Ungemach found *etesipe* relatively common at Youbdo, and described the female of the Abyssinian race, one of which was captured at Tchellea in the centre. In both sexes the ground-colour of the underside is olive-green instead of reddish-brown, particularly in the male.

Charaxes achaemenes Fldr.

"German South West Africa, Natal to Abyssinia, and thence on the south side of the Sahara to Senegambia, but wanting in the West African subregion."

Hodson. Males, 4. Locs. 7, 11, 13.

Ungemach found it common on the Baro and the Didessa, but did not take it elsewhere.

Charaxes protoclea Feisth.

Ungemach often saw in the highlands a superb *Charaxes* flying very rapidly which eluded capture : "probablement une race particulièrement grande de *protoclea azota* Hew."

Charaxes boueti rectans R. & J.

"Abyssinia."

Hodson. Males, 4. Locs. 13, 14.

Ungemach took near the Didessa, a damaged male the underside of which was "franchement fauve, et non orange-orpiment."

Charaxes lactetinctus ungemachi Le Cerf.

Three examples taken by Ungemach at Youbdo. The species in nominotypical form is found in the Togo hinterland, Adamaua, the Gold Coast, Cameroons, between Scarcies and the Niger river; in northern Uganda, and on the Masisi hills south of Mt. Elgon and north of Mumias.

Charaxes lactetinctus ungemachi Le Cerf f. **brunneus** forma n.
(Pl. XI, fig. 21.)

Hodson. Male, 1. Loc. 59. The type specimen.

A distinct form, in which the wings are mahogany brown with no trace of the bluish-white except on the hind-wing where the submarginal spots at the anal angle and in areas 2 and 3 have a faintly blue suffusion. The margin, between the tail on vein 2 and the anal angle is bright green. The basal halves of the wings are slightly paler brown than the periphery, and on the fore-wing the pattern, which in *C. lactetinctus* is brown between black markings, is here distinguishable as a lighter brown. A narrow black disco-cellular spot on the fore-wing : the other black spots on upper surface in the same position as those on under surface of *C. lactetinctus* which mark the outer edge of the black which borders the basal blue. There is also a faint black spot near the base of area 5, less well marked than in *C. lactetinctus,* corresponding with the outermost of the costal pale streaks on under surface.

Markings of under surface as in *C. lactetinctus*, but the two pale streaks running back from the costa are narrower than in *C. lactetinctus* and not of such a silvery white, being rather yellowish.

The hind-wing is slightly greyer beneath than in *C. lactetinctus.*

Charaxes numenes Rthsch.

"Abyssinia."

Hodson. Males, 2. Locs. 56 (19.ii.25), 59 (23.i.27).

Ungemach took several at Youbdo.

Charaxes tiridates marginatus R. & J.

"Abyssinia."

Hodson. Males, 3. Locs. 13, 43 (1927), 45.

Ungemach found it common enough at Youbdo, and also took it on the Guebba. He noted that the discal blue spots are larger than in typical *tiridates* and that the sub-costal spot and sub-apical spot in area 7 are white and not blue. The females also differ from typical *tiridates* in the absence of the submarginal white spots on the fore-wing in areas 3, 4, 5.

Charaxes etheocles Cram. ♂ f. *hollandi* Btlr.

Hodson. 16. Locs. 13, 32 (18.i). 34, 37, 43 (1927), 45 (1927), 56 (19.ii.25, 27.i.27).

Males trans. from *hollandi* to *catochrous* Strand, 5. Locs. 11, 45 (1925), 56 (7.ii.25).

♂ form *lutacea* Rthsch., 1. Loc. 56 (7.ii.25).

Males with more uniform grey-brown underside, markings indistinct, 2. Locs. 41, 42.

Ungemach found *etheocles* common; he did not distinguish between the ♂ forms, but specifies ♀ forms *daria* R. & J., and *vansomereni* Poulton. Strand (1911B) reported ♀ form *viola* Btlr.

Charaxes candiope Godt.

" Sierra Leone to Abyssinia and Natal."

Hodson. Males, 9. Female, 1. Locs. 43, 45 (1925), 53, 56 (19.ii.25, 27.i.27), 59 (1927), 65 (31.xii.26, 12.i.27).

Ungemach found it the most widely distributed representative of the genus.

Charaxes varanes vologeses Mab.

" The whole of west and east Africa."

Hodson. Males, 3. Females, 3. Locs. 11, 13, 64 (4.i.27), 65 (8.xii, 12.i), 69.

Scott. Male, 1. Loc. H.

Ungemach took this often in the centre and in Wallega.

Charaxes zoolina Westw.

" Natal to Uganda and Abyssinia."

Hodson. Males, 4. Trans. to *neanthes*, 1. Locs. 21 (April), 22, 23 (3.x).

Charaxes zoolina Westw. f. *neanthes* Hew.

Hodson. Males, 14. Locs. 21 (Sept.), 22, 43 (1927), 45 (1925), 51, 56 (27.i), 59 (1927), 65 (12.xii.26, 12.i.27).

One specimen bears a distinct beak mark of a bird.

ab. *obscuratus* Suff. Male, 1. Loc. 56 (10.ii).

The two forms are common, but never abundant, according to Ungemach.

Euryphene mardania F.

" Gold Coast to Angola and Uganda."

A specimen was seen by Ungemach, but could not be caught; he considered that it was very probably this species.

Euphaedra inaequabilis Thur.

" Uganda."

Males and females captured by Ungemach were indisputably of the same species and he therefore claimed that, as Aurivillius says (*in* Seitz, *Grossschmett. Erde*, **13** : 184), the name *peculiaris* given by Lathy to the male must fall. Ungemach, however, found his males, which are evidently not *losinga* Hew. to which Aurivillius ascribes *inaequabilis*, to differ from *peculiaris* by certain characters. He called these specimens *Euphaedra inaequabilis abouna* Ung. This form was very abundant in darker parts of the forests of Youbdo, but was not found elsewhere.

Euphaedra medon L.

" Sierra Leone to Uganda."

In the Tring collection there is a specimen from the Upper Gilo River.

Euphaedra sarita abyssinica Rthsch.

" Abyssinia."

Euphaedra preussi neumanni Rthsch.

" Abyssinia."

Hodson. Males, 6. Females, 6. Locs. 2, 4, 5, 8, 19, 69.

The pale areas vary from yellow to greenish-white. The under surface of a male from loc. 2, has black margins posterior to the pale bar on the fore-wing, and along the anterior and inner sides of the pale area of the hind-wing there is black. In two females, from loc. 2, on the underside the pale area of the hind-wing extends outwards to the submarginal row of spots.

Euphaedra preussi perochrata Ung.

Ungemach described this from a male captured at Youbdo in which " une teinte brun-orange remplace entièrement la couleur verte de *preussi*, sauf à l'extrême limite de l'aire claire des deux ailes." A female, probably of the same race, had the sub-costal white band on the under surface of the hind-wing broken in the middle.

Hamanumida daedalus F.

Universal.

Hodson. Males, 5. Females, 3. Locs. 25 (April), 29 (April). These have the under surface grey to light yellow, almost without white dots.

Males, 4. Female, 1. Locs. 17 (Oct.), 18, 19, 23 (8.x). Specimens with the under surface dusky purplish brown, the markings less distinct.

Ungemach took this form on the Baro and in the Didessa basin.

Hamanumida daedalus Fab. f. *meleagris* Cr.

Hodson. Males, 4. Female, 1. Locs. 17 (Oct.), 19, 29 (April).

Ungemach considered that this distinctly white spotted form " est hivernale en général."

Hamanumida daedalus Fab. f. *bicolor* Ung.

A form captured at Khora " en Somalie " with the outer margin of the fore-wing strongly concave. The spots are indistinct, without white, except in the cells where they are dark brown. The basal half of the two wings is " brun franc assez clair " : the distal half greenish brown. It appears probable that this is an individual aberration, but the number of specimens captured is not stated.

Aterica galene Brown.

" Sierra Leone to Angola and Lake Albert Nyanza." Its distribution extends through Uganda to the southern Sudan.

Hodson. Males, 12. Females, 4. Locs. 4, 8, 34, 36, 41, 43 (10.ii), 51, 57, 59 (23.i.27), 65 (10.xii.26, 3.i.27).

Ungemach found this, and *theophane* with it, common at Youbdo, rarer on the Baro and the Didessa.

Aterica galene Brown f. *theophane* Hpff.

" Portuguese and German East Africa."

Hodson. Males, 2. Females, 4. Locs. 4, 36, 39 (18.ii), 43 (10.ii).

Ungemach found that both forms often have a black tooth which penetrates, sometimes deeply, the yellow spot, and considered that the unique male described as *incisa* by Rothschild and Jordan is merely an aberration of this type.

Pseudacraea boisduvali Dbl., f. *sayonis* Ung.

Ungemach took this form at " Oumbi, Sayo " : the yellow subapical band is much straighter than in *trimeni* Btlr. to which the form is closely allied, and is elongated and narrower, the apex of the triangle reaching the subcostal nerve. Between the orange band and a large black spot which covers the extremity of the cell there is a blackened area. This is faintly indicated in some specimens of *trimeni*.

Hodson. Female, 1. Loc. 19. Somewhat transitional between *sayonis* and *trimeni*.

Pseudacraea eurytus L. f. *terra* Neave.

" Uganda."

Hodson. Female, 1. Loc. 36.

There is a very slight basal reddish suffusion on the under surface of the hind-wing, indicating a slight approach to the next form. (See my papers on *Pseudacraea eurytus* in 1913, *Trans. ent. Soc. Lond.*, **1913** : 606 and 1923, *loc. cit.*, **1923** : 469.) The model for this form, in Abyssinia, would be *Bematistes epaea homochroa* Jord.

Pseudacraea eurytus L. ♀ f. *tirikensis* Neave.

" Uganda."

Hodson. 2. Loc. 36, 52.

There is a slightly yellow tint around the anal angle of the hind-wing, more marked on the under surface.

Pseudacraea eurytus L. ♀ f. *epaeoides* Ung.

This, taken at Youbdo and described as a species " plus ou moins du groupe d'*eurytus*," is like a pale *terra*, with elongated subapical area on the fore-wing from costa to hind margin which it reaches between veins 3 and 4. The pale areas are " jaune ocre pâle " : there is no red-brown basal triangle. Specimens of this appearance but with the subapical area not elongated, taken by Captain I. G. Owen of the Sudan Defence Force at Bendere, on the Congo-Nile watershed, southern Bahr-el-Ghazal, Sudan, in 1934, were exhibited to the Royal Entomological Society of London on November 7th, 1934 (1934, *Proc. R. ent. Soc. Lond.*, **9**).

Pseudacraea eurytus L. ♀ f. *lachesis* Ung.

A black and white female form, taken at Youbdo, the fore-wing of which has much the pattern of *tirikensis* save that the white subapical band is narrower and extends (as in the preceding form) further towards the hind margin. The hind-wing has the white discal area bordered with grey on the inner side of the black margin. There is a red-brown basal triangle.

Pseudacraea eurytus L. f. *youbdonis* Ung.

An extremely interesting form, described from a male captured at Youbdo. The basal half of each wing, to the end of the cell, is orange-brown, the rest of the wing is grey-brown. The underside is similar, but lighter: there is no basal triangle. There are the usual black spots at the bases of the wings and in the cell of the fore-wing.

Hodson. Female, 1. Loc. 42. This is the neallotype. See Pl. XI, fig. 26.

Resembles the male, but on the fore-wing the orange-brown basal area extends beyond the end of the cell to the bases of the internervular rays. The hind-wing, between the orange-brown base and the distal dark border, is suffused with paler almost yellowish tint.

There is a male of this form in the British Museum, from the Godman-Salvin collection bearing labels: " W. Africa, ex Horniman. Fuller. Isubu." Captain I. G. Owen has shown me a female captured by him 3 March, 1934, at Bendere, Bahr-el-Ghazal, on the Congo–Nile watershed, near the boundary between the Belgian Congo and French Equatorial Africa. This form, as Ungemach says, is undoubtedly closely allied to *striata* Btlr. This " species " has not hitherto been linked with *eurytus*, but a specimen also captured by Captain Owen at Bendere, very strongly suggests that *striata* is linked to *P. eurytus tirikensis* through *youbdonis*. In this specimen, a female, there is on the fore-wing a white subapical band slightly tinted with yellow scales, the ground-colour being brownish black, suffused with reddish-brown scales along the inner margin posterior to vein 2. This reddish-brown suffusion is more strongly marked at the base of the hind-wing, and fades away towards the blackish hind margin. The underside of the hind-wing has no definite basal triangle but the red suffusion is very strong at the base. Jordan has figured a specimen which resembles this (1910, *C.R.* 1^{er} *Congrès int. Ent.*, Bruxelles, **2**: Pl. xxiii, fig. 23*a*). It is interesting to note that Captain Owen took at Bendere a specimen of *tirikensis* as well as this intermediate, and *youbdonis*. I examined the male genitalia of typical *striata*, *eurytus terra*, *eurytus hobleyi*, and *eurytus ruhama*, and could find no adequate means of distinction between them.

Pseudacraea eurytus L. f. *mimo-ras* Ung.

This most interesting addition to the protean *eurytus*, according to its discoverer, " mime d'une façon parfaite la race abyssinie de *Planema* [i.e. *Bematistes*] que j'ai nommée *ras*." The male and female, from Youbdo and Oumbi, are alike. The general appearance is of the form *poggeoides* Poult., with an orange subapical band across the black fore-wing running a slightly straighter course than in *poggeoides*, in the female larger and " plus claire " : and there is in the female " le long du bord dorsal, une étroite bande blanchâtre enfumée." The hind-wing in the male has no white band but a diffuse grey patch : in the female the greater part of the hind-wing is white. On the underside there is a well-marked red-brown basal triangle.

The coloured figure given by Ungemach imparts a decidedly pinkish tinge to the orange which also appears in that of the model, but this is not the case in the actual specimen.

Pseudacraea lucretia walensensis E. Sh.

" Somaliland, Abyssinia."

Hodson. Males, 8. Females, 2. Locs. 19, 41, 42, 43 (1927), 45 (1927).

Ungemach found it widespread, and variable, especially beneath. The form was described by E. M. Sharpe (1896) from specimens taken by Donaldson Smith, who gave the locality on his map as " Mt. Walengo "—the " g " appears to have been misread for " s " in naming. A feature that is conspicuous in this form is the paleness of the base of the hind-wing on the underside; the usual strongly marked triangle is indicated by an ill-defined pale yellowish suffusion.

Pseudacraea lucretia walensensis E. Sh. f. *protracta* Btlr.

" Congo." Extends to Uganda.

Ungemach took two females at Youbdo and Bouré.

Pseudacraea lucretia walensensis E. Sh. f. *expansa* Btlr.

Strand (1911A) described " ab. *eliana* " from a single female from " Eli."

Neptis saclava marpessa Hpff.

" Cameroons to Abyssinia and Cape Colony."

Hodson. Males, 7. Female, 1. Locs. 14, 22, 23 (9.x), 34, 45 (1925), 51.

Scott. 1. Dj. (7–9.x.26).

Ungemach found this common in Wallega and on the Didessa, but it was absent from the centre.

Neptis nemetes obtusa R. & J.

" Abyssinia."

Hodson. Males, 5. Locs. 36, 43 (1927), 51 (3.ii).

Neptis agatha Stoll.

" Sierra Leone to Abyssinia and Natal."

Hodson. Males, 18. Females, 22. Locs. 7, 9, 10, 11, 13, 17, 19, 23 (3.x), 32 (18.i), 34, 51, 64 (1925), 65 (9–25.xii). 66.

Scott. 1. Loc. M.

Ungemach found it one of the commonest of insects, both on the plains and in wooded parts.

Neptis melicerta Drury.

" Sierra Leone to Angola and Abyssinia."

Hodson. Males, 10. Female, 1. Locs. 2, 36, 45 (1925), 51, 65 (10–12.xii).

There seems to be a difference between western and eastern specimens : in the former the white subapical spots on the fore-wing are longer than in the latter. Hodson's specimens are of eastern types.

Ungemach found it not very common, and localised to certain points in Wallega.

Cyrestis camillus F.

" Sierra Leone to the Congo and Abyssinia."

Hodson. Males, 11. Female, 1. Locs. 34, 49, 54 (1925, 1927), 56 (19.ii), 59 (1927), 61, 63 (1927).

Ungemach found it only in Wallega.

Crenis occidentalium Mab.

" Sierra Leone to North Angola and Abyssinia."

Hodson. Males, 5. Locs. 35 (Jan.), 44, 56 (1927), 65 (24.xii).

Widely spread throughout Wallega and on the Baro, but not reaching the Didessa, according to Ungemach. Extraordinarily abundant in places.

Crenis boisduvali kaffana R. & J.

" Abyssinia."

Hodson. Males, 5. Locs. 32, 39 (7.iii), 47, 63 (1925), 65 (10.xii).

The male genitalia cannot be distinguished from those of *b. boisduvali* from Uganda.

Ungemach wrote of this as less widespread than the preceding, not occurring on the Baro, but often met in inconceivable quantity. " Aucun papillon n'atteint une pareille densité de population." He described a form, ab. *uniformis*, in which the reduction of markings on the under surface, characteristic of *kaffana* is carried further so that on the fore-wing there is only a " vague nuage " beyond the apex of the cell.

Crenis garega Karsch.

Hodson. Males, 4. Locs. 32 (18.i), 35, 59 (1927), 60.

Not abundant in Wallega, and not found elsewhere, by Ungemach. Well-known synonyms of this species are *ansorgei* R. & J. and *natalensis* Hpff.

Crenis umbrina Karsch.

" Togoland, Unyoro, Uganda."

Hodson. Males, 2. Loc. 48.

According to Ungemach, fairly widely spread in the west centre, between " Didessa and Guibbé "; exceptional in Wallega.

Byblia ilithyia Drury.

Universal.

Hodson. Males, 7. Locs. 21 (30.xi), 22, 23 (28.iv), 29 (28.ix, 2, 12.x).

Byblia ilithyia Drury f. *polinice* Stoll.

Hodson. Males, 6. Locs. 21 (30.xi), 23 (2.x), 25 (29.iv), 30.

Byblia ilithyia Drury f. *aestivalis* Ung.

Dire-Dawa.

Differs from typical *ilithyia* by " dessus, teinte plus claire, moins orange et plus ocrée." Black markings of fore-wing reduced.

Byblia acheloia acheloia Wallengr.

" South Africa to Abyssinia."

Hodson. Males, 5. Female, 1. Locs. 36, 56 (7.ii), 64 (11.i), 68.

Scott. Male, 1. Loc. Zw. (1.xi.26).

Bullock. Male, 1. Loc. Mk.

Ungemach recorded an extreme dry-season form in which the underside of the hind-wing is of so deep " brun marron " that the black lines are not seen, and contrasting with the three bands of creamy-white spots.

Byblia acheloia acheloia Wallengr. f. *vulgaris* Stgr.

Hodson. Males, 4. Females, 2. Locs. 3, 6, 8, 29 (16.iii), 69, 70.

Scott. Males, 2. Loc. Zw. (1.xi.26).

Bullock. Males, 2. Loc. H.B.

Ungemach found this wet-season form as common in the west as in the centre.

An aberration to which Strand gave the name *albitrimaculata* is from " Eli."

Byblia acheloia crameri Auriv.

" Sierra Leone to Angola and Uganda."

Taken by Ungemach at Abassena and Bouré at the same time as the last, but not flying with it : he considered *crameri* a distinct species.

Neptidopsis ophione velleda Mab.

" German East Africa to Abyssinia."

Hodson. Males, 22. Female, 1. Locs. 3, 8, 32, 34, 44 (1925, '27), 45 (1925), 51, 65 (10–23.xii).

These are not very strongly of the eastern race ; the amount of red-yellow at the anal angle of the hind-wing being very little in some cases.

Ungemach found it common throughout Wallega and on the Didessa.

Eurytela hiarbas abyssinica R. & J.

" Abyssinia."

Hodson. Males, 19. Locs. 32 (18–22.i), 34, 44 (1927), 52, 53, 54 (1927), 55, 64 (9.i.27), 65.

Widely distributed, according to Ungemach, in all Wallega and the Centre, as well as on the Didessa.

Eurytela dryope angulata Auriv.

East Africa.

Hodson. Males, 9. Females, 2. Locs. 11, 19, 22, 44 (1925, '27), 45 (1927).

Scott. Males, 6. Female, 1. Locs. D., Zq., Zw.

Fairly common in Wallega, rare in the centre, according to Ungemach.

Kallima ansorgei Rthsch.

" Uganda, and the interior of the Cameroons near Babungo."

Hodson. Males, 5. Females, 4. Locs. 39 (18.ii), 53, 54 (1927), 56 (1927), 57 (9.ii), 59 (1927), 65 (25.xii.26).

These show a distinct difference from a series from Kenya Colony, Nyangori. The Abyssinian specimens have, in the male, the marginal dark part of the wing blacker, instead of a grey-brown, and the markings in it less distinct. The blue is a truer blue, and has less of the greenish tint. Ungemach records *ansorgei* as rare, from Oumbi and Youbdo.

Hypolimnas misippus L.

Universal.

Hodson. Males, 6. Females, 4. Locs. 21 (April), 23 (April, 2, 3, 14.x), 29 (Sept.), 63 (1927).

Ungemach found the species " remarquablement peu en Abyssinie." The typical form taken on the Baro, the Ouama, and at Youbdo.

Hypolimnas misippus L. ♀ f. *inaria* Cr.

Hodson. Females, 2. Locs. 23 (2.x), 59 (1927).

Taken by Ungemach at Boché and on the Baro.

Hypolimnas misippus L. ♀-f. *dorippoides* Auriv.

The record of this form given by Rothschild and Jordan (1903, p. 524) is, I am informed by Dr. Karl Jordan who kindly looked into the matter in response to a query, a mistake. " The name *dorippoides* (instead of *inaria*) was a slip, caused by the misleading name *dorippoides* : the Abyssinian females of *misippus* are all without white on the hind-wing. Later collections also did not contain any *misippus* females with white hind-wing."

Hypolimnas salmacis platydema R. & J.

" Unyoro and Abyssinia."

Ungemach found it only at Youbdo, very rare, and in Oumbi forest, common.

Hypolimnas dubia dubia Beauv. f. *damoclina* Trim.

Hodson. Female, 1. Loc. 69. Agrees well with a long series from Sierra Leone.

Hypolimnas dubia dubia Beauv. f. *anthedon* Dbl.

Ungemach found these two *western* forms much the commonest : the species being abundant in Wallega and on the Baro.

Hypolimnas dubia mima Trim.

The eastern race.

Rare ; found by Ungemach at the same time and place as the above.

Salamis temora Fldr.

" Old Calabar to Angola, German East Africa, Abyssinia."

Hodson. Males, 6. Locs. 34, 43 (1927), 44 (1927), 47, 65 (21.xii).

Ungemach took it at various places in Wallega, very abundant at Youbdo.

Salamis parhassus aethiops Beauv.

" Old Calabar to the Cape and Abyssinia."

Hodson. Males, 12. Female, 1. Locs. 2, 32 (Jan.), 34, 46, 54, 61.

Quite abundant in Wallega, up to the Didessa.

Salamis anacardii nebulosa Trim.

" Natal to Unyoro and Abyssinia."

Hodson. Female, 1. Loc. 12.

A very " dry " specimen; the under surface russet-brown except for whitish patches on the inner margin of the fore-wing and an oblique dark streak on the hind-wing.

Ungemach remarks that *parhassus* frequents the western plateaux, but *anacardii* only occurs in the tropical belt of Abyssinia, at " Djaoué (Baro), et à Gotha (Somalie)."

Salamis cacta F.

" Sierra Leone to Congo and Abyssinia."

Hodson. Males, 25. Female, 1. Locs. 43 (1925), 46, 56 (7.ii.25, 27.i.27), 59 (1927), 61, 63 (1927), 65 (11.xii).

Ungemach only took it at Oumbi.

Catacroptera cloanthe Stoll.

" Angola to the Cape and Abyssinia."

Hodson. Males, 2. Loc. 30.

Scott. Males, 2. Locs. Dj. (25–29.ix), C. (11.xi).

Ungemach found the species restricted in range: at Youbdo, Tchirri.

Catacroptera cloanthe ligata R. & J.

" Sierra Leone to Togo."

Two individuals from Wallega have the characters of *ligata* which has not hitherto been recorded from Abyssinia.

Precis chorimene Guèr.

" Senegal to Congo and Abyssinia."

Hodson. Males, 6. Female, 1. Locs. 11, 12, 14, 69.

The account given of *chorimene* collected by Hodson (Carpenter 1928 : 40) is incorrect and the figures now given are the revised statement. Three of the males are transitional to *angulata* on the underside. Two males and three females are the aberration *orthosia* Klug. Locs. 11, 12, 14.

Ungemach found the species very common throughout the west, rarer in the east (Goudder): the majority are of the aberration *orthosia*.

Precis chorimene Guèr f. *angulata* Auriv.

" Abyssinia."

Hodson. Males, 6. Locs. 6, 9, 10, 12, 14. Scott. Male, 1. Loc. C. (14–16.xi).

This form was taken by Ungemach at Abassena.

Precis terea terea Drury.

" Sierra Leone to Angola and Uganda."

Ungemach recorded this as excessively common, and typically western, and not belonging to the race *fumata*.

Precis terea terea Drury f. *januarii* Ung.

A dry-season form taken in January at Youbdo, in which the underside is " presque uniformément gris beige " divided by the median line into blackish outer part and pale yellow inner part.

Precis terea fumata R. & J.

" On the borders of Angola and in Somaliland."

Hodson. Males, 29. Females, 4. Locs. 6, 32 (21.i), 34, 35, 36, 51, 65 (7–28.xii.26, 11.i.27), 69, 70.

Bullock. Males, 2. Females, 4. Loc. L.

These specimens differ strongly from a series collected by me in the Didinga mountains, S.E. Sudan, which agree with Ungemach's. (Carpenter 1928.) Hodson's specimens (Pl. XI, fig. 22), have the dark area of the fore-wing not only broadened on the proximal side of the yellow band, but also along the costa so that the yellow is suffused with black anterior to vein 5 and much contracted. A specimen from Toro, Western Uganda, 1900, in the Hope collections is of the same type.

Precis limnoria limnoria Klug.

" Arabia and Abyssinia."

Hodson. Males, 3. Female, 1. Locs. 20, 21, 29.

The female is slightly transitional to *taveta*.

Precis limnoria taveta Rog.

"German and British East Africa, Somaliland."
A specimen in the Tring Museum came from Harar.

Precis coelestina Dew.

"Cameroons to Angola, Uganda, Somaliland."
Hodson. Male, 1. Loc. 19.
Ungemach took a single male at Oumbi.

Precis coelestina Dew. f. *jordani* Auriv.

Hodson. Male, 1. Loc. 68.
This is the wet-season form.

Precis tugela Trim.

"Natal to Nyasaland."

Hodson. Males, 18. Females, 7. Locs. 32 (22.i), 34, 50, 52, 56 (27.i), 59 (1927), 61, 64 (4, 7.i.27), 65 (7–29.xii).

The fore-wing has the strongly-hooked tip, and the underside the dead-leaf brown with strong oblique line, characteristic of a dry-season form. The band is yellow in all the females.

Hodson. Males, 5. Locs. 32 (21.i), 34, 59 (1927), 65 (15–16.xii).

A wet-season form, with fore-wings less strongly hooked, and underside more mottled.

Ungemach found this species widely spread but never common, and mentions the variability of the underside, and the paler band of the female.

Precis milonia Fldr.

"Cameroons and Congo."

Strand (1911B) recorded this in a collection made by Kostlan in "Abyssinia," but the three males are "Ohne nähere Angabe."

Precis actia Dist.

Recorded by Butler (1898) from the Harar highlands, 4000–8000 ft. But as no other record has been obtained from Abyssinia this is possibly a mistake, and the species was probably *pelarga*.

Precis pelarga F.

"Senegal to Angola and Abyssinia."
Only found at Billo, in June. (Ungemach.)

Precis pelarga F. f. *galami* Bdv.

Hodson. Male, 1. Loc. 11.
Ungemach took this in June on the Didessa, as well as at Billo.

Precis pelarga F. f. *leodice* Cr.

The commonest form in the west from the Baro to the Orguessa in April and May, and at Youbdo in December, according to Ungemach. The aberration *harpyia* F. from Bouré and Youbdo is rare.

Precis ceryne Bdv.

" Angola to Natal, and in East Africa to Uganda and Abyssinia."

Ungemach records this as rare but scattered over the plains of the centre and Wallega.

Precis ceryne Bdv. f. *tukuoa* Wallengr.

As above, in November to January.

Precis antilope Feist.

Southern Congo, South Africa to Natal, East Africa to Abyssinia, and again in Senegal.

Precis octavia Cr.

" Sierra Leone to the Congo, Abyssinia, and Somaliland."

Hodson. Males, 43. Females, 22. Locs. 32 (22.i), 64 (1925), 65 (Dec. 1926–Jan. 1927).

These have a distinct facies. The pink colour is not so bright as in the east African race, but is not so brownish as in the western race. The pattern has a characteristic great development of the black at the base of both wings. In only three (male) specimens is there a distinct break between the posterior end of the outer bar, and the inner marginal black which sends a bar forwards to meet the former. The basal red costal mark on the fore-wing is on the whole reduced, and in some cases is lost in the black so that the red patch in the cell is the only one in the large black basal area of both wings. This development of black as in Somaliland specimens from the Golis Mts. is more than in typical western *octavia*. (Pl. XI, figs. 23, 24, 25.)

Scott. Male, 1. Loc. D.

Ungemach found it very widespread in Wallega, rarer in the centre up to the Goudda.

Specimens transitional from *octavia* to *amestris* :—

Hodson. Males, 17. Female, 1. Loc. 65 (Dec. 14–Jan. 14).

Scott. Females, 2. Loc. Dj., October.

Precis octavia Cr. f. *amestris* Drury.

Hodson. Males, 25. Females, 13. Loc. 64 (1925), 65 (Dec. 7–Jan. 7).

Scott. Males, 3. Females, 3. Loc. C., Dj. (1–3.x, 7–9.x).

Ungemach found it, but rarely, from time to time in Wallega.

Precis sophia sophia F. and
Precis sophia infracta Rog.

There are 6 males and 1 female in the Hodson collection, taken in localities 32, 65 (7–17.xii), and 70, which are nominotypical *sophia*. There is the following material of ssp. *infracta* Rog. :—

Hodson. Males, 1. Females, 15. Locs. 26 (Sept.), 32 (18–28.i), 37, 65 (25–27.xii).

Scott. Male, 2. Loc. Dj. (7–9.x). One is transitional to *albida*.

Precis sophia infracta Rog. ♀ f. *albida* Suff.

Hodson. Females, 4. Locs. 26 (Sept.).

Scott. Male, 1. Female, 1. Loc. Dj. (21–23.xi, 7–9.x).

Ungemach found *infracta* and *albida* equally common and widespread.

Precis sophia infracta Rog. f. *leucotincta* Strand.

" Abyssinia."

Hodson. Males, 16. Locs. 26 (31.iii, 10, 15.ix), 32 (18–22.i), 34, 38, 60, 61, 63 (1925), 65 (17, 20, 27.xii).

Scott. Male, 1. Loc. Dj. (7–9.x).

The fact that all the *leucotincta* are males; and all the *albida* females, is suggestive; there is probably little real difference between the two aberrations.

Precis westermanni Westwood.

" Gold Coast to Angola."

Hodson. Males, 19. Locs. 34, 47, 54 (1925), 56 (7, 19.iii.25, 27.i.27), 63 (1927), 64 (7.i), 65 (21.xii).

These are like the specimens to which Rothschild and Jordan refer (1903, p. 513), as agreeing with *suffusa* in some details: they seem to come nearest to the *East* African race of *westermanni*, having two subapical spots and the pattern on the underside not so heavily marked with black; while the pale area extending forwards from the anal angle and near the margin is very strongly contrasted with the costal area. The specimens are variable and some are very near *suffusa.*

Two specimens in the British Museum collected by Zapphiro in 1906 from " Choga Kullo, 5200 ft." and " In the forest, Sadatcha Goma, 5100 ft." agree with Hodson's, and Ungemach's appear to be of the same form: he found it common in Wallega.

Precis westermanni Westwood ♀ f. *lugens* Ung.

Described from a female taken at Bouré: blackish, with a narrow white band on the fore-wing which, like the white median area of the hind-wing has a violet reflection. The pattern of the underside like the upper, but the black replaced by yellow ochre shaded with grey-brown.

Precis oenone cebrene Trim.

Universal south of Sahara.

Hodson. Males, 4. Female, 1. Locs. 7, 21, 22, 25, 29.

Common in Wallega and the Centre.

Precis clelia Cr.

Universal.

Hodson. Males, 5. Female, 1. Locs. 14, 23, 64 (1925, 1927), 65 (13.xii), 67.

Scott. Male, 1. Loc. Zw.

Strand's numerous trifling aberrations from " Abyssinia " are not considered here. Ungemach found this common from the Baro to the East.

Precis orithyia madagascariensis Guen.

" Congo to Natal and Abyssinia."

Hodson, Males, 4. Females, 6. Locs. 15, 18, 19, 23, 29, 44, 65 (27.xii.26, 8.i, 14.i.27).

These do not show the reduction of the orange markings on the underside of the base of the fore-wing mentioned by Rothschild and Jordan (1903 : 511.) and agree with specimens from the Didinga Mountains (Carpenter, 1928) and East Africa.

Scott. Male, 1. Loc. Dj–A.

A small specimen, with no orange in the cellular markings on the underside of the fore-wing.

Ungemach found it the commonest *Precis* on the steppes.

Precis orithyia here Lang.

" Arabia."

Reported by Butler (1898) from the Harar highlands, 4000 to 8000 ft.

Vanessa cardui L.[1]

Hodson. Males, 2. Locs. 29, 64 (9.i).

Scott. Males, 3. Females, 4. Locs. Dj–A. (20.ix), Dj. (1–3, 7–9.x), D., L. (2.i.27).

Widely spread but never very abundant, according to Ungemach.

Antanartia abyssinica Fldr.

" Kilimandjaro to Abyssinia and Ruwenzori."

Hodson. Males, 7. Locs. 55, 56, 64 (15.ii.25), 65 (7.xii, 14.xii).

Scott. Males, 3. Locs. C., Zq.

Bullock. Male, 1. Loc. Al.

Ungemach found it " fort rare dans le domaine exploré par moi, sauf à Addès-Abeba même, où elle est commune."

Antanartia hippomene Hbn.

" Cape to Abyssinia and Ruwenzori : also in the interior of the Cameroons."

Hodson. Males, 22. Locs. 26 (31.iii), 32 (18, 21.i.25), 37, 55, 56 (19.ii.25, 26.i.27), 59 (1925, 1927), 65 (30.xii.).

Scott. Males, 4. Locs. C., Zq., Dj. (21–23.ix).

Antanartia schaeneia diluta R. & J.

" Abyssinia."

Hodson. Males, 30. Females, 2. Locs. 32 (18.i.25), 34, 39, 46, 47, 49, 54 (1925), 55, 56 (19.ii.26, 26–7.i.27), 58, 59 (1927), 65 (25.xii, 3.i.27).

Scott. Males, 3. Loc. Dj. (25–28.ix, 7–9.x).

Ungemach found it " Peu commune, Centre et Ouallaga."

Phalanta columbina columbina Cr.[2]

" Sierra Leone to Natal, British East Africa, and Uganda."

Hodson. Males, 8. Locs. 45 (1925), 56 (10.ii), 61, 65 (12.xii, 1–8.i).

These specimens have an expanse of wing averaging 50·5 mm., and ranging from 49 to 52.

Phalanta columbina microps R. & J.[2]

" Somaliland and Abyssinia."

Scott. Males, 6. Females, 3. Loc. Dj. (21–23.ix, 7–9.x).

These have an expanse of wing averaging 43 mm. in the males and 46 mm. in the females, ranging from 41–46 in the former and from 45–48 in the latter. They show the dark purplish-brown on the under surface of the base of the hind-wing, and of the part of the fore-wing not covered by the hind-wing in repose, characteristic of this race. The sub-marginal spots on the hind-wing are punctiform and not well shown.

---

[1] Placed by Aurivillius in the genus *Pyrameis* Hübn.

[2] Placed by Aurivillius in the genus *Atella* Doubleday.

Ungemach recorded this race as widely spread, often abundant in the Centre and in Wallega.

Evidently the extreme south-west corner of Abyssinia is not frequented by it, for Hodson did not take it : high altitudes may be necessary to it.

Phalanta phalantha aethiopica R. & J.[1]

" The whole of Africa."

Hodson. Males, 4. Locs. 14, 22, 30, 65 (13.xii).

One specimen, from loc. 14 has the venation which distinguishes *columbina* (Rothschild and Jordan 1903, p. 506), but agrees with the three others in appearance.

Scott. Males, 3. Loc. M.

Ungemach only found this in the extreme west, on the Baro and the Birbir.

Argynnis hyperbius neumanni R. & J.

" Abyssinia."

Hodson. Males, 37. Females, 9. Locs. 24, 26 (31.xii.24, 15.ii), 32 (21.i), 38, 47, 54, 55, 56 (27.i), 60, 64 (15.ii), 65 (15–30.xii, 13.i).

The species does not seem to go much below 6000 ft. altitude, and most of the specimens were from higher elevations.

Scott. Male, 1. Females, 2. Locs. C., Dj. (21–23.ix, 1–3.x).

Bullock. Male, 1. Loc. Al.

Ungemach records it as scattered from the Goudder to Gore : it appears to be absent from the Gillett Mountain region (Rothschild and Jordan 1903).

Melitaea abyssinica Oberth.

Abyssinia and Southern Arabia.

I am indebted to Dr. Hugh Scott for calling my attention to a paper by Warnecke (1933) referring to Oberthür's description of a *Melitaea* from Abyssinia, and the fact that the same butterfly occurs in Southern Arabia. Mr. G. Talbot has carefully examined the specimens, and considers that they cannot be included under the species *didyma*, a conclusion with which Mr. N. D. Riley agrees. I am also indebted to Dr. L. G. Higgins, F.R.C.S., who is making a special study of *Melitaea*, for his opinion that *abyssinica* " is certainly quite distinct from *didyma* " : but he considers it to be a local form of *deserticola* Oberth. The presence of *abyssinica* in Southern Arabia, while *deserticola* is known in Arabia only from the extreme north (as well as in Palestine and the Arabian desert between the Red Sea and the Nile), rather suggests that *abyssinica* should be separated from *deserticola*. Mr. Talbot's note on this species is as follows :—

Melitaea abyssinica Oberth.

Oberthür, 1909, *Étud. Ent.*, **3** : 243, 244 ; id., *loc. cit.*, **10** : pl. 282, figs. 2303–4 (*M. didyma abyssinica.*)

The types, ♂♀, of this insect are in the British Museum. The general arrangement and scheme of markings is as in *didyma* Ochs. The markings of the upperside are heavier than in any *didyma*, the marginal spots on the forewing connected, and the submarginal row only separated by the veins. The ochraceous colour is paler than in most *deserticola* Oberth. (the pale N. African *didyma* race). The ochraceous colour of the underside is still paler than the upperside.

---

[1] Placed by Aurivillius in the genus *Atella* Doubleday.

On the fore-wing the mark in the discal cell near vein 2 and the mark at the end of the cell are placed closer together than in *didyma*, the mark at the end of the cell being placed at a short distance from the cross-veins; in *didyma* this mark is placed against the cross-veins. The submarginal spot in 2 is represented by a dot which is placed proximad of the spot above it; in *didyma* the spot in 2 is large and square, very rarely a dot, and always placed directly below the spot above it, the inner edges of the two spots being about in line. On the hind-wing the spots are larger and more rounded than in the more heavily marked specimens of *deserticola*, but the arrangement is similar: this is one important difference. The inner edge of that part of the discal band which lies in cellule 1*c* is placed well proximad of vein 2, and is on a line with the outer edge of the band crossing the cell, the two edges forming a continuous black line; in *didyma* the posterior part of the discal band is more distal, and the pale spot of ground-colour in the cell is therefore open below the cell, being closed in *abyssinica.*

The two important differences on the fore-wing, and the one on the hind-wing, so differentiate this insect from *didyma* that it must be treated as a distinct species, although evidently derived from *didyma.* It occurs also at Aden.

In the British Museum there are four specimens of what appears to be another race of this species from Lebanon, Beyrouth, and Transjordan.

[G. Talbot.]

The next four species to be dealt with are usually assigned to the genus *Planema* Doubleday, but Mr. Francis Hemming informs me that this use is invalid and that these species are at present without a valid generic name. Mr. Hemming has accordingly been kind enough to prepare the following diagnosis of a new genus for the reception of these species :—

Bematistes gen. n., Hemming.

Generic characters—I select as the generic characters of *Bematistes* Hemming, the characters given for *Planema* Doubleday by Aurivillius in 1913 (*in* Seitz, *Grossschmett. Erde* **13**: 239).

Type: *Bematistes umbra* (Drury, 1782) (= *Papilio umbra*, Drury, 1782).

For a statement of the reasons for the introduction of the above generic name, see my note in Appendix 1 (p. 435).

[Francis Hemming.]

Bematistes alcinoë nado Ung.

Described from a male captured at "Bouré." A female from the same locality probably belongs here.

Hodson. Male, 1. Females, 2. Loc. 4.

This is obviously closely allied to *B. alcinoë camerunica* Auriv., the chief characteristic being the limitation of the orange-brown colour on the hind-wing to a basal black-spotted triangle beyond which the orange of *camerunica* is replaced by yellowish-grey running into the grey-black border. In Hodson's male there can be seen on the fore-wing faint traces of the black shading which in specimens of *camerunica* from Uganda forms a bar from the costa through the tip of the cell to nerve 2, and also of the darker basal suffusion. These darker markings are slightly better developed on the under surface.

The under surface of the hind-wing shows the basal red triangle to be less yellow-red and more crimson red than in *camerunica*, and the area between it and the dark marginal band is decidedly white and not yellowish grey as in *camerunica*. Hodson's two *females* differ very slightly in minor points. Ungemach has not described the female of his species, but merely mentions one of the chief differences from the female of *B. alcinoë camerunica*. The following notes are therefore given (Pl. XII, fig. 27). The *female* is black and white but the tint on the fore-wing is slightly browner than in *camerunica* from Uganda : especially is this shown proximally to the white bar where, in Uganda specimens, the black is deeper than elsewhere. The very great majority of Uganda *camerunica* have a strong black projection into the proximal edge of the white at the base of area 3, which is wanting in Hodson's females. Also, as Ungemach says, the margin of the white is more proximal, cutting through the end of the cell, whereas in the great majority of Uganda *camerunica* the black projection obviates this. The more crimson colour of the basal triangle of the hind-wing, to which reference was made in the male, is also evident on the upperside of one of the two specimens : in this one the black border of the hind-wing is as broad as in *camerunica*, its proximal edge reaching half-way between the tip of the cell and the hind margin, whereas in the other specimen the border is narrower, its proximal edge being at the junction of the outer and inner thirds of the space between the margin of the wing and the tip of the cell.

The spotting of the base of the hind-wing has one feature which may be of diagnostic value, but its significance cannot be yet established. The male and both females lack a black spot at the base of area 6 just external to the discocellular nervule which is generally present in *camerunica*. Sixty-one specimens from Entebbe all possess this spot, and all but one of thirty-five from Kome, one of the Sese islands in Lake Victoria : the remaining specimen shows only a trace of the spot on the left side and no trace on the right.

The crimson-red basal triangle of the under surface of the hind-wing shows, in the female, a tendency to run out as radiating streaks in areas 5 and 6 which is not the case in *camerunica*.

The specimen of *nado* female which is not figured differs slightly in having slight white suffusion of the black in area 1*b*, and in the cell of the fore-wing.

The male genitalia (fig. 1) show slight differences in proportions from those of *B. alcinoë camerunica* (fig. 2), but probably not enough to justify specific distinction.

Dr. C. Le Doux, who has a large experience of these organs in *Bematistes*, wrote that he was of the same opinion after he had seen a preparation, from an Oxford specimen, which was sent to him : he also made a preparation from the abdomen of a female captured by Hodson which was sent him and reported that " the armature is identical with that of *alcinoe*."

Bematistes aganice orientalis Ung.

Described from two males captured at " Bouré."

Hodson. Males, 4. Females, 3. Locs. All save one from 19; 1 male from 43 (1927).

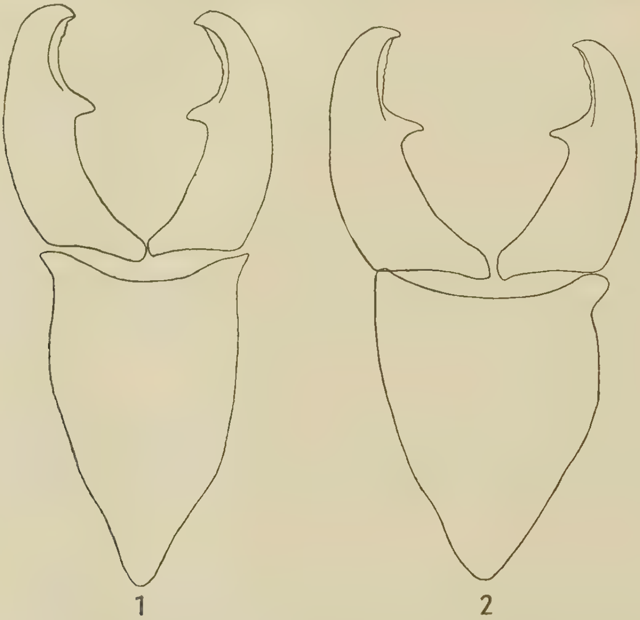
The orange of the male is deeper than in *B. a. aganice* Hew. but not so deep as in *B. a. montana* Btlr. : the width of the bands is as in *B. a. aganice*, or may even be slightly narrower on the hind-wing. But the general hue of the ground-colour is the brownish-black of *B. a. montana* rather than the deeper black of *B. a. aganice*.

The female, not described by Ungemach, has relatively narrow pale bands, but the black is brownish as in *a. montana*, and in its own male.

Bematistes poggei ras Ung.

Described as a sub-species of *Bematistes nelsoni*; but *nelsoni* itself being only a race of *poggei*, Ungemach's nomenclature requires alteration. It is described as like *leopoldina* Auriv., and differs from *nelsoni* " par le fait que la bande médiane orange englobe le sommet de la cellule, ainsi que par la courbure très régulière et la largeur uniforme (8–10 mm.) de cette bande, dont la limite intérieure est indentée seulement par une protubérance de l'aire basale noire qui remplit la base de l'intervalle 3." The orange band is " orange-foncé " in the male, " orange-vif " in the female : the whitish band of the hind-wing is wider and whiter in the female. Taken in Wallega at " Hôkissis, Youbdo, et sur la Guebba " : it is closely copied by a new form of *Pseudacraea eurytus* (q.v.).

A specimen in the British Museum captured on 28 May, 1905, by P. C. Zaphiro at " Charada, Kaffa, 6000 ft." appears to belong to this race of *poggei*. In pattern it agrees closely with Ungemach's figure and description, but the orange bar of the fore-wing has not the deep, almost pinkish, orange given it in Ungemach's coloured plate : it is of a rather pale yellowish-orange : the specimen is, however, old and worn. The genitalia are very like those of *B. poggei nelsoni* so far as the claspers are concerned, but the proportions are somewhat different (figs. 3 and 4). Further specimens are required before it can be stated whether *ras* is entitled to specific rank : Dr. C. Le Doux agrees with me that this is doubtful.



Figs. 1–2.—(1) *Bematistes alcinoë nado* Ungemach. S.W. Abyssinia, Got river, 15.xi.25 (*A. W. Hodson*). (2) *Bematistes alcinoë camerunica* Auriv. Entebbe, Uganda.

Bematistes epaea homochroa R. & J.

" Abyssinia."

Hodson. Males, 4. Female, 1. Locs. 46, 53.

Ungemach found it only at Bouré and Youbdo.

Acraea alciope schecana R. & J.

" Abyssinia."

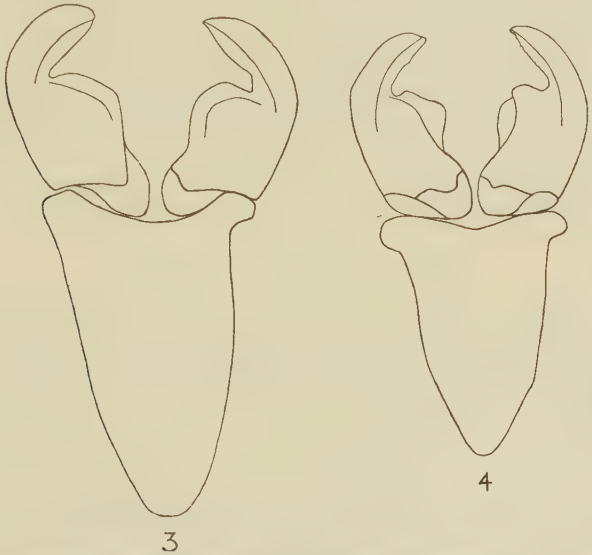
Hodson. Males, 5. Locs. 34, 45, 53, 61, 65 (10.xii.26).

These agree with Uganda specimens of *A. a. alciope* in having the black border to the hind-wing broader than in West African *A. a. alciope*; the chief characteristic of the race is the prolongation backwards of the end of the black bar on the costa of the fore-wing so that it protrudes into the yellow in area 2 over the base of vein 3, giving a hooked tip to the bar. A suggestion of this hook is seen in Uganda specimens better than in specimens from West Africa, although one specimen from " Manyema, Congo Free State," in the Tring Museum agrees with *schecana*.

Ungemach does not mention the appearance of his males, but states that " *alciope* Hew." is very abundant at Youbdo and Oumbi.

♀ form *macarina* Butlr.

Ungemach recorded this " sans bordure noire aux ailes post."



FIGS. 3–4.—(3) *Bematistes poggei nelsoni* Sm. Entebbe, Uganda. (4) *Bematistes poggei ras* Ung. S.W. Abyssinia, Charada, Kaffa, 6000 ft., 28.v.1905 (*Ph. C. Zaphiro*). In the National collection.

A specimen taken by Hodson, while near to *macarina*, has a broad black border to the hind-wing, occupying one-third of the total width; the bases of areas 1*a*, 1*b*, 1*c*, 2, 3, 4 and the posterior third of the cell all have a dusting of yellow scales forming a pale patch.

♀ form *vidua* Ung.

A most interesting novelty, figured by Ungemach, with white bands on both wings: in his specimen it appears that the remainder of the hind-wing is " fauve." A specimen taken by Hodson has a white streak along area 1*a* of the fore-wing in its outer half, of which the outer part is suffused with brownish-yellow scales. The broad dark border of the hind-wing is also suffused with brown, along the inner half, in areas 3, 4, 5, which seems to be a transition to Ungemach's yellow hind-wing. Other female forms cited by Ungemach are *cretacea* Eltr. and *fumida* Eltr.

Acraea esebria Hew., form near *monteironis* Btlr.

Hodson. Males, 2. Female, 1. Locs. 19, 20.

The male has the pale areas lemon yellow; in the female they are white. In the male the pale area on the hind margin occupies the middle of areas 1*a* and 1*b* and a small triangle at the base of area 3: the sub-apical area is large and wide. The pattern is that of *monteironis* but the colour yellow instead of white: the female corresponds to *monteironis*. The distribution of *monteironis* is given as "Angola, Mashonaland, East Africa."

Acraea jodutta aethiops R. & J.

"Abyssinia."

Hodson. Female, 1. Loc. 55.

The subapical orange area hardly differs from the tawny orange of the hind marginal area, except that it is slightly paler along the costa and in area 7.

Ungemach found it rare, except at Oumbi.

ab. *clara* Ung. is characterised by general reduction of black. The apical quarter of the cell of the fore-wing is ochre; the hind marginal spot is linked to the subapical band by a suffusion of ochre.

There were also taken females of the form *dorotheae* E. Sharpe, and the form of the latter with white subapical bar which Schultze and Aurivillius named *integra* was captured twice in the Alenga Valley. Ungemach ascribed these, with some doubt, to *inaureata* Eltr., but having seen his specimens I am allowed by M. Ungemach to state that the true name is as given above.

Acraea lycoa aequalis R. & J.

"Abyssinia."

Hodson. Males, 8. Female, 1. Locs. 26 (8, 15.ix), 34, 65 (13, 25.xii).

Two of the males have the black border of the hind-wing strongly suffused with reddish, especially on the inner side and near the anal angle. Ungemach found it common enough in the west, as far east as the "Ouama," but absent from the Baro: it varies little.

Acraea servona God.

Hodson took a series of *servona* which shows to a greater extent than other specimens a character of which the beginnings may be seen in other localities. The description is as follows:—

Acraea servona God. f. **digitata** forma n.

"Abyssinia."

Hodson. Males, 6. Female, 1. Locs. 45 (1925), 46, 50, 59, 65 (9, 16.xii).

The central yellow area of the hind-wing is rayed out distally into the black so that the proximal edge of the black border is deeply scalloped (Pl. XII, fig. 28). In area 4 the yellow ray projects well beyond the rays from other areas to as much as 1½ mm. beyond them. The dark parts of the under surface are less red than in *rhodina* though more red than in *servona*; they may be brownish-black, with the outer edge of the border of the hind-wing yellow: the inter nervular rays are broader than usual in the hind-wing.

Type. A male from locality 46. The genitalia are indistinguishable from those of *A. s. servona*.

It is not possible to determine from Ungemach's paper whether the specimens of *servona*, which he records, belong to this form or not.

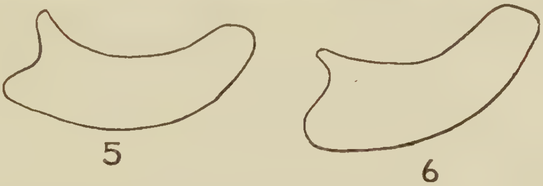
Acraea ungemachi Le Cerf.

" Abyssinia."

Hodson. Males, 16. Female, 1. Locs. 36, 45, 56 (7.ii.25), 63 (1925), 65 (12.xii).

This is closely allied to *penelope*, but there are differences in the genitalia (compare figs. 5 and 6) : the clasper of *ungemachi* being less rounded at the tip, and blunter. All the specimens differ from *penelope* by having the three subapical spots on the fore-wing in areas 4, 5, 6 of the same red as those in 1*b* and 2. The spot in 3 (usually transparent and sometimes faintly tinted with red, and rather variable in shape and size in *penelope*) is absent or faintly indicated and its maximal development is never greater than the minimal of *penelope* : it is red like the others. Some specimens have a linear suffusion with red on the fore-wing just behind the cell at the base of area 1*b* and there may be a red streak within the cell ending in the streak in 3. The hind-wing resembles that of *penelope* on the upperside, but the basal spots beneath are smaller, less conspicuous, and may be reduced in number.

The expanse of wing is one or two millimetres less than in *penelope*; the female, hitherto unknown, has a wing expanse of 52 mm. Hodson's specimen (Pl. XII, fig. 29) is therefore the neallotype : in pattern it is like the male, but all the spots are yellow, and those in areas 4, 5, 6 of the fore-wing are less thickly scaled than in areas 1*b* and 2 : this greatly helps the likeness to *servona* conferred by the yellow colour.



Figs. 5–6.—(5) *Acraea penelope* Stgr. Uganda. (6) *Acraea ungemachi* Le Cerf. S.W. Abyssinia, Nado's Province, Meti Chafe, 4560 ft., 4.ii.1925 (*A. W. Hodson*).

The female neallotype was taken at locality 45 on 4 February, 1925.

Ungemach found the species not rare in Wallega, especially at Oumbi, and comments on its variability, especially in regard to the basal spots on the underside.

Acraea ungemachi Le Cerf f. *nuda* Ung.

The whole base and centre of both wings uniformly orange beneath.

Acraea peneleos gelonica R. & J.

" Abyssinia."

Acraea safie safie Fldr.

" Abyssinia."

Hodson did not take the typical form with the band on the hind-wing fully developed.

Ungemach recorded specimens from the Centre (" Tchelléa, Toké ") as of this form.

Scott. Males 7, Females, 2. Loc. Dj. (25–29.ix.26).

Acraea safie antinorii Oberth.

" Abyssinia."

Hodson. Males, 10. Females, 1. These specimens have a feebly developed band on the hind-wing just reaching area 2. Locs. 34, 47, 55, 56 (26, 27.i.27), 59.

The following are transitional to the next form, but have, at least, traces of spots just visible on the hind-wings. Males, 27. Locs. 28, 32 (18.i.25), 33, 34, 49, 56 (7, 19.ii.25, 26.i.27), 59 (8.ii.25, 24.i.27).

Scott. Males, 2. Loc. Dj. (25–9.ix.26).

Acraea safie antinorii Oberth f. *neumanni* Le Doux.

Hodson. Males, 12. Locs. 28, 32 (21.i.25), 34, 35 (25.i.25), 45 (1925), 56 (7, 19.ii.25, 27.i.27), 59, 65 (12.xii).

These have no traces of spots on the hind-wing. Hodson's specimens entirely support Ungemach's contention that no distinction separates *antinorii* from *neumanni* as they grade imperceptibly one into the other. He found that these less heavily marked forms frequent the west (" Baro excepté "), and that *safie* is commoner in winter, *antinorii* in summer.

Ungemach named two aberrations : *albipuncta* with large white spots on the fore-wing and none on the hind-wing ; *oumbiana* with fore-wing like the last, but a very straight orange brown band across the hind-wing.

Acraea orina orineta Eltr.

" Uganda."

Ungemach found this only very rarely at " Ouroumou, et sur la Guebba."

Acraea cinerea alberta Eltr.

" To the west of Lake Edward."

Found at Youbdo by Ungemach but very rare.

Acraea encedon encedon L.

Universal.

Hodson. Males, 7. Females, 6. Locs. 6, 14, 17 (12.iii.25), 23 (8–11.x), 26 (10.ix, 26.xii), 64 (15.ii.25), 65.

Ungemach's views about the species are given here to save repetition :— nominotypical *encedon* is less common than form *infuscata,* which is dominant everywhere ; form *daira* Godm. is the only form at Dire-dawa in the east ; form *lycia* (*lycioides* Le Doux) and form *sganzini* are found with nominotypical *encedon* ; a single form *fumosa* was taken at Bouré. It was rarely found at an altitude above 2300 m.

Samples of Hodson's forms were sent to Dr. Le Doux, who has made a special study of the western and eastern races of the species : the identifications given below are by him.

Acraea encedon encedon L. f. *sganzini* Bdv.

Hodson. Male, 1. Loc. 37.

Acraea encedon encedon L. f. *lycioides* Le Doux.

Hodson. Males, 6. Females, 6. Locs. 8, 14, 17 (28.x), 23 (5–11.x), 26 (15.ix), 65 (17–20.xii), 67.

Bullock. Males, 3. Loc. H.B., Mk.

Acraea encedon encedon L. f. *carbonaria* Le Cerf.

Hodson. Male, 1. Loc. 14.

Acraea encedon encedon L. f. *poultoni* Le Doux.

Hodson. Males, 3. Female, 1. Locs. 23 (5–6.x), 29 (28.ix), 65 (16.xii).

Acraea encedon encedon L. f. *daira* G. & S.

With subapical black bar present. Hodson. Males, 7. Locs. 6, 8, 14, 18, 44 (1925), 64 (1925), 65 (17.xii).

Without black bar. Hodson. Males, 4. Females, 4. Locs. 23 (5.x), 26 (15.ix), 29 (23.iv), 65 (13, 20, 30.xii).

Bullock. Female, 1. Loc. L.

The forms of *encedon* are seen to be typically eastern : Dr. Le Doux kindly reported that they do not differ from ordinary East African forms. It is noteworthy that the western form *alcippina* is not recorded, and that the black and white form was determined as the eastern representative *lycioides* and not the western *lycia* F.

Acraea encedon necoda Hew.

Hodson did not take this.

Scott. Males 7. Female, 1. Loc. C.

This interesting form confined to Abyssinia raises the common problem of whether it should be given specific rank. Eltringham (1910, *African Mimetic Butterflies* : 36), judging from Hewitson's original figure (1861, *Exot. Butts.* : (Acraea), pl. 2, fig. 9) thought *necoda* to be an intermediate between *lycia* and *infuscata*. Le Doux (1931, *Mitt. zool. Mus. Berlin*, **17** : 254–5) left the question open to personal opinion. He drew attention to the dark, spotted abdomen of *necoda*, different from that of most *encedon* but occasionally approached by a few specimens from Abyssinia : this change can only have taken place recently and may become permanent in time. The sexual armature is also pigmented in both sexes of *necoda*.

Ungemach is strongly of the opinion that *necoda* is a distinct species : he did not find it with *encedon* but mentions that Neumann did (Le Doux, 1928, p. 113), and I find that Scott took both on Mt. Chillalo on the same day. The following differences are urged by Ungemach : " *necoda* a une structure plus coriace " and makes a rustling noise when flying : the almost transparent fore-wings are larger and more rounded. The discal spots of the hind-wing are not sharply marked and rounded as in *encedon* but transversely elongated, and with soft outlines : they lie nearer to the end of the cell (particularly well seen in area 3), and the same is true of the spots on the fore-wing, of which that in area 3 is at one quarter of the distance from the cell to the margin in *necoda* but in *encedon* is at one-third. The eight specimens of *necoda* collected by Scott, compared with the *encedon* collected by him and Hodson completely bear out what Ungemach and Le Doux have said, and, judging by external appearance, one would have no hesitation in classifying *necoda* as a species. But examination of the male genital apparatus does not support this, and I can find no difference constant enough to justify specific rank. The tips of the claspers are more rounded and less pointed than in some specimens of *encedon*, but a specimen transitional between *sganzini* and *lycioides* was similarly formed (compare figs. 7–14).

Le Doux found no specific difference, but remarked that the genital armature showed some resemblance to the West African race *lycia* (sensu stricto). I find, however, that a dorsi-ventral view of the genitalia of *necoda* shows an outline at the base like the straight sides of the East African specimen figured at fig. 4 on Pl. II by Le Doux (1931) and has not the curve of the West African race *lycia* (figs. 3 and 10). Dr. Le Doux kindly examined samples of the Abyssinian *encedon* and reported that they showed no western affinities : the black and white specimens were of his eastern race *lycioides* and not the true western *lycia.* The facts suggest that *necoda* is an old inhabitant, *encedon* a more recent invader from East Africa : the original strain perhaps having come from West Africa.

Acraea pharsalus rhodina Rthsch.

" Uganda and Abyssinia."

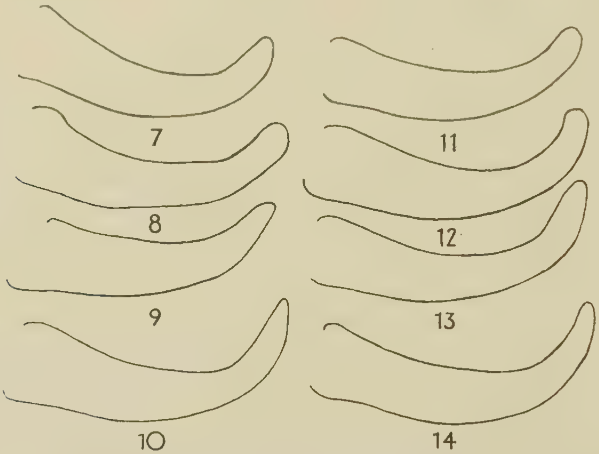
Hodson. Male, 1. Loc. 34.

Ungemach found this very common in all the west, including Baro : the specimens had the red subapical band better developed. The general colour is a fine red like that of *A. perenna kaffana* Rthsch.

Acraea cabira Hpff. f. *karschi* Auriv.

" Cameroons and British East Africa."

Hodson. Males, 2. Loc. 65 (16–17.xii).



Figs. 7–14.—(7) *Acraea e. encedon* L. form *encedon* L. S.W. Abyssinia, Gosha Waha, 2100 ft., 10.x.25 (*A. W. Hodson*). (8) *A. e. encedon* L. form *lycioides* Le Doux, trans. to *sganzini* Bsd. S. Abyssinia, Doukham, 6500–7000 ft., 18–20.x.26 (*H. Scott*). In the National collection. (9) *A. e. encedon* L. form *lycioides* Le Doux. S.W. Abyssinia, Akula river, 1800 ft., 31.x.25 (*A. W. Hodson*). (10) *A. e. encedon* L. form *lycioides* Le Doux. Data as for fig. 8. (11) *A. e. encedon* L. form *daira* G. & S. S.W. Abyssinia, Kibish river, 2900 ft., 23.iv.25 (*A. W. Hodson*). (12) *A. encedon necoda* Hew. S. Abyssinia, Mt. Chillalo, 8000 ft., 11.xi.26 (*H. Scott*). In the National collection. (13) *A. e. encedon* L. form *daira* G. & S., an unusually pale specimen. S. Abyssinia, plains north of Lake Zwai, 5500–6000 ft., 1.xi.26 (*H. Scott*). In the National collection. (14) *A. e. encedon* L. form *daira*, G. & S., transitional, with large spots as in ab. *macropunctata* Le Doux. Data as for fig. 8.

Acraea cabira Hpff. f. *natalensis* Stgr.

" Natal to German East Africa."

Ungemach recorded this as common from the western limit of Wallega to the basin of the " Guibbé."

Acraea cabira Hpff. f. *apecida* Oberth.

" Congo and German East Africa."

Specimens in the Tring Museum from L. " Abassi " (Awusa) and the neighbourhood, have the red patch near the hind margin of the fore-wing narrower than in specimens from East Africa.

Acraea bonasia banka Eltr.

" Abyssinia."

Hodson. Males, 5. Females, 2. Locs. 34, 39 (7.iii), 56 (19.ii.25), 65 (17–24.xii).

The above specimens are transitional to *banka*, having slight radiating streaks on the black border of the underside of the hind-wing, but the sub-basal spots arranged as in *bonasia*.

Males, 40. Female, 1. Locs. 27, 28, 32, 34, 37, 38, 39 (7.iii), 46, 65 (8–25.xii), 66, 67.

A single specimen from loc. 38 has an abnormal under surface : the pale areas are suffused with black and the spots enlarged into internervular basal black blotches. One specimen from locality 27 bears distinct evidence of the attack of a bird in the form of a beak-mark.

Ungemach remarked that his specimens confirm the opinion that *alicia* and *banka* are forms of one species.

There are in the Hope collection at Oxford two specimens of *banka* from Freetown, Sierra Leone.

Genitalia of males of Hodson's *banka* show no difference from those of typical *bonasia*.

Acraea bonasia alicia E. Sharpe.

" Cameroons, Uganda, British East Africa."

Specimens in the Tring Museum from localities near L. Abassi, Sidamo, agree best with the eastern form *alicia*. Aurivillius (1922) records *alicia* from " L. Abbai."

Acraea bonasia alicia E. Sharpe ♀ f. *cabiroides* Poult.

Recorded by Ungemach.

Acraea sotikensis E. Sharpe.

" Congo, Angola, and Rhodesia to Uganda, Abyssinia, British East Africa."

Hodson. Males, 4. Loc. 26 (10.ix).

These have the subapical band yellow : the red in the cell is limited to a streak only 1 mm. broad at its outer end and thinning to a linear mark at the base of the cell : it is sharply cut off from the red spot in area 2 by a black bar connecting the costal black with the hind marginal black. The central orange patch of the hind-wing is more strongly bayed out towards the margin of the wing in areas 4 and 5 than is usual in *west* African specimens, in this agreeing with specimens from Kenya. Another eastern feature is the unspotted black border of the hind-wing which in western specimens is spotted with narrow yellow triangles.

Acraea acerata Hew. f. *tenella* Rog.

" Nyasaland to Abyssinia."

Hodson. Males, 14. Female, 1. Locs. 11, 23 (6.x), 26 (8–10.ix), 27, 28, 29 (16.iii), 41, 45, 57, 70.

These are intermediate between *acerata* and *tenella* : in colour typically *acerata*, and the subapical and hind-marginal patches quite separated by a broad black bar. But in the female and three males there are, on the black border of the hind-wing, traces of the red-brown radiating streaks in the internervular spaces characteristic of *tenella*.

Ungemach found this species very common in the west, except on the Baro, less common in the centre and not passing further east than the Guibbé river. Very variable both in shade and markings, but ascribed to the form *tenella*.

Acraea acerata Hew. f. *vinidia* Hew.

Specimens in the Tring Museum are as pale as *tenella*, but the under surface agrees best with West African specimens : they come from localities in Kaffa (Bonga), Shoa (Kollu), and on the Abai River (Madali).

Acraea terpsichore L.

The forms of this difficult species are so many, and intergrade so finely, that it is impossible to fit them by definite divisions into such a table as Le Doux (1928) has drawn up. The specimens collected by Hodson are grouped as follows :—

A. *terpsichore terpsichore* L. The pale spots on the underside of the fore-wing in the apical black border are separated from each other and from the pale subapical area by black margins. The black subapical bar may or may not be complete. Two males from loc. 3, one female, loc. 3, have the pale spot on the margin in area 3 of the fore-wing greatly elongated inwards, on the under surface of the hind-wing the spots are scattered; in the two males there are red stripes in areas 1*c* and the cell and an indication in area 7.

B. Transition to *ventura* Hew. The apical pale spots on the underside of the fore-wing beneath not delimited by black, and more or less merging into the ground-colour. The hind-wing beneath has a trace of red bordering the marginal pattern and red stripes unite spots in area 7, the cell, and 1*c*. Three males from loc. 26, 10th Sept. One female from same locality, 8th Sept., has the upperside greatly suffused with black, the ground-colour being greyish-yellow : the black border is wider, the subapical pale area and marginal spots on the fore-wing reduced; on the hind-wing the basal pale area almost everywhere is suffused with black, but to a smaller extent on the proximal side of the black border in which the pale spots are only conspicuous in areas 1*c*, 2, 3. Under surface light yellow, whitish over the basal half of the fore-wing, the distal ends of the veins on fore-wing black : on the hind-wing spots small and few, with a red streak in 1*c* and the cell : no red on proximal side of marginal pattern.

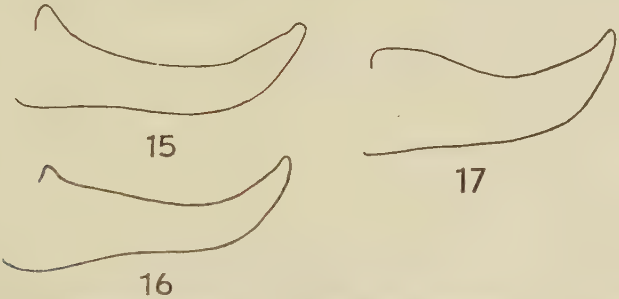
C. Three aberrant males, which the genitalia (fig. 15) show to be a form of *terpsichore* (fig. 16) but which form a series in which the spots of the underside of the hind-wing become gathered into a closely packed, almost solid, black band crossing the wing through the cell. In extreme specimens the result is a resemblance to *A. bonasia banka* and the name *Acraea terpsichore* L. ab. **bankoides** ab. n. is proposed here for this aberration (Pl. XII, fig. 32).

The type comes from loc. 32, and was taken 21.i.25. Upper surface tawny orange with complete black subapical bar. The black border to the fore-wing rather narrower than usual, with no pale spots. Black spot in the cell joined to the subcostal black. Base of fore-wing black for a distance of two millimetres. A black streak occupies area 1*a* on the fore-wing from the base to the level of a conspicuous spot on vein 1. The black border of the hind-wing has small inconspicuous orange spots in 1*c*, 2, 3 and a minute orange fleck in 4.

The under surface has a greater resemblance to *banka*. Fore-wing orange-brown with yellow subapical area: the black bar is broken at the outer extremity. The black border has large yellow spots elongated into streaks anterior to vein 4: they do not communicate with the pale subapical area. Black spot in cell isolated. Hind-wing yellow-brown, the black border has in each internervular area a large pyramidal yellow spot. The black spots are fused into an almost complete, slightly irregular bar bent at a slight angle at vein 5: there is a free spot in the base of the cell and black marks in area 8.

A second specimen from loc. 32 has not quite lost the marginal spots on the upperside of the fore-wing, and on the hind-wing they are as in the type specimen. The black subapical bar is wider and more complete than in the type specimen, producing a greater resemblance to *banka*. The spots on the underside of the hind-wing show through to the upper surface, and there is also a slight suffusion with black scales from the base to the end of the cell which aids resemblance to *banka*. The under surface differs from the type in the arrangement of the spots to form two parallel rows as in *ventura* but the shading in between is black, not red.

A third specimen from loc. 65, 22.xii.26, is transitional. The upperside resembles the female mentioned under A: the spots on the underside of the hind-wing are in a position intermediate between typical *terpsichore* (A) and *bankoides*.



Figs. 15–17.—(15) *Acraea terpsichore* L. ab. *bankoides* Carpenter. S.W. Abyssinia, Shoa Ghimira Province, 21.i.25 (*A. W. Hodson*). (16) *A. terpsichore terpsichore* L. S.W. Abyssinia, Aloru river, 1400 ft., 17.xi.25 (*A. W. Hodson*). (17) *A. maji* Carpenter. S.W. Abyssinia, Maji Province, 7700 ft., 15.ix.25 (*A. W. Hodson*).

D. A long series of a well-defined form in which the genitalia (fig. 17) show distinct differences in shape from those of *terpsichore* (fig. 16): specific rank is therefore accorded.

Acraea maji, sp. n.

Generally resembles *A. terpsichore ventura*. The ground-colour is a slightly more yellowish orange: the subapical orange area slightly narrower along the veins. The subapical bar may, or may not, be complete, it is so in the specimen taken as type (Pl. XII, fig. 36). The marginal orange spots in each internervular area except 1*a* on the fore-wing and hind-wing are linear, as they may be in *ventura*, but on the hind-wing whereas in *ventura* they are rounded in *maji* they are very narrow, about twice as long as broad. Disco-cellular spot on hind-wing well marked in all specimens, thickened at the posterior end. The spot often present in *terpsichore* in the cell and joined to the subcostal black is not present in the type of *maji* although it can be seen in a minority of the specimens. Under surface of fore-wing (Pl. XII, fig. 33): pattern as in *ventura*, the orange internervular areas darker than the yellow subapical area with which they are continuous without any black separating them : the subapical area as on the upperside, narrower than in *ventura*. The chief difference from *ventura* is in the detail of the under surface of the hind-wing : the pattern and coloration on the whole are those of *ventura*. The marginal yellow spots are less sharply pointed and more truncated and merge gradually into the brick-red which lies between the arrowhead markings. These brick-red patches are wider, between the barbs of the black arrowhead markings, than in *ventura*. Body, head and palps as in *ventura*.

The type, and fourteen other males, was taken by Hodson on 15th Sept. at loc. 26, 7700 ft., 15.ix.26 : there is another male from the same locality, 8th Sept.

A difficult point is raised by a female taken at the same locality on 10th Sept. (as also were those males previously mentioned under B). The general facies is that of *maji*, but the under surface (Pl. XII, fig. 37) is typical *terpsichore* as regards the scattered spots on the hind-wing and the complete absence of red stripes. The apical pale spots of the fore-wing border on the underside merge into the subapical area without any black margin. If this is the female of *maji* it is curious that the hind-wing pattern should be different, and without red, for in *ventura*, which *maji* resembles, there is not this difference between the sexes. Possibly this female is not that of *maji* and further specimens are required to settle the point.

Strand (1911, B) has described an aberration of *terpsichore* from " Eli " under the name " *toka* " : his " *eliana* " is considered by Le Doux and Aurivillius to be *rougeti* Guér.

Le Doux (1928) gave the name *reducta* to a form from Suk-suk river, 1400–1500 metres, collected in April 1925 by Neumann, in which the black margins are greatly reduced.

My investigations into the male genitalia of *maji* necessitated preparations from many specimens of *terpsichore* and species like it for comparison. It became clear that there was considerable variation, and that much work is needed.

Acraea jordani Le Doux.

Ungemach took seven males and seven females at Youbdo. He gave an excellent figure and description ; the description and figure given by Le Doux (1928) are of an abnormal specimen which, unfortunately, was taken as the type of the species : it came from " Djakorssa, Djimma."

Acraea natalica abadima Ribbe.

" Angola to Cameroons, Uganda, Abyssinia."

Hodson. Males, 4. Female, 1. Locs. 6, 13, 17 (Oct.), 29, 45 (7.ii.27).

Acraea natalica abadima Ribbe f. *pseudegina* Westw.

" Senegal to Nigeria."

Ungemach took specimens " très proche de *pseudegina*," the north-western race. There are specimens labelled *pseudegina* in the Tring Museum from Kocha.

Acraea natalica abadima Ribbe ♂ f. *umbrata* Suff.

" Mozambique to British East Africa."

Ungemach recorded specimens of this eastern race " sans aucun doute " on the Baro, together with *pseudegina*.

Acraea caecilia F.

Senegal to Nigeria, Uganda, Nubia, Abyssinia, Somaliland, East Africa.

This widely spread and common species was only captured twice by Ungemach on the Baro, and does not appear in the Hodson collection.

Acraea oncaea Hpff.

" South and East Africa to the southern Congo region and Abyssinia."

Acraea doubledayi Guér.

" Abyssinia and Somaliland."

Ungemach found this only at Dire-dawa.

Acraea doubledayi Guèr. f. *rileyi* Eltr.

Abyssinia.

This form was taken by Capt. I. G. Owen in April and May 1932 at Torit, Mongalla Province, S. Sudan, the first specimens recorded outside Abyssinia (Carpenter, 1933).

Acraea caldarena Hew.

" Natal to Damaraland and British East Africa."

Hodson. Males, 2. Female, 1. Locs. 21 (25.iv), 23 (5.x).

This common species seems scarce in Abyssinia : Hodson's record is the only one known to me.

Acraea pudorella Auriv.

" German and British East Africa ; Abyssinia."

Acraea braesia Godm.

" German and British East Africa ; Abyssinia."

Acraea perenna kaffana Rthsch.

" Abyssinia."

Taken abundantly by Ungemach at Youbdo : a single specimen also on the " Ouama." One male had a large black spot in area 3 of the hind-wing : otherwise there is little variation.

Acraea egina egina Cr.

" Senegal to Angola, Nyasaland and Uganda."

Hodson took a single female at loc. 41. The western character is emphasised by the fact that this specimen is of the female form *alba* described by Eltringham (1913, p. 412), and noted as very like the form *medea* from Principe, West Africa (Eltringham 1917).

Acraea egina Cram., form near *areca* Mab.

" South East Rhodesia, Nyasaland, German and British East Africa."

Ungemach only took one male and one female of this species, at Youbdo which he doubtfully assigned to *areca :* they differ by " une plus forte extension du noir." I have seen the specimens : possibly they constitute a distinct race, but more specimens are required. The spots on the fore-wing are larger and more confluent.

Acraea zetes sidamona R. & J.

" Abyssinia."

Hodson. Male, 1. Female, 1. Loc. 6.

The male is not quite so pink on the underside of the fore-wing as the type specimen, but otherwise agrees well (Pl. XII, fig. 30).

Ungemach took numbers between the Baro and the Didessa, but found considerable variation as regards the red spots at the base of the wing, and the discal black band. The most constant character is the black band on the under surface of the fore-wing isolating the subapical reddish area from the orange submarginal spots.

The form *sidamona* as its authors point out (1905) is near *jalema* Godt., which is intermediate between the eastern *acara* Hew. and the western *menippe* Drury. It has less black on the fore-wing than *menippe*, but agrees with it in the spotted black border of the hind-wing. The underside of the fore-wing of *jalema* may show a trace of the black border which in *sidamona* separates the subapical patch from the submarginal spots. A characteristic feature of *jalema* noticed also in the original description of *sidamona*, is the elongated submarginal orange spot on the underside of the fore-wing in area 6 which in *jalema* is continuous with the subapical reddish patch as in *menippe*: in *sidamona* the black band already mentioned interrupts it. The form *sidamona* is thus probably derived from the population of northern Uganda, Kenya, and southern Sudan.

It is with difficulty distinguished in the male from the form *rudolfi* described by Eltringham (1929) from two males and a female collected at Marsabit, south-east of Lake Rudolf, by Van Someren. The type of *rudolfi* has the subapical tawny orange patch slightly larger so that the black bar separating it from the submarginal tawny orange is slightly thinner. Both agree in the spotted black margin of the hind-wing, in the pink hue of the under surface, and the elongated orange submarginal spot on the under surface of the fore-wing in area 6 which is separated by the black bar from the subapical tawny orange patch. But the female *rudolfi* is like the male, while the female of Hodson's *sidamona* has the fore-wing largely greyish white, except for the submarginal orange spots.

Acraea zetes oscari Rthsch.

" Abyssinia."

Hodson. (Transitional from *sidamona*, Pl. XII, fig. 34.) Males, 10. Locs. 24 (31.iii), 56 (26–27.i, 7.ii), 54 (1925).

True *oscari* (Pl. XII, fig. 35). Males, 19. Females, 4. Locs. 24 (20.ix), 26 (10.ix), 47, 54 (1925), 55, 56 (26–27.i, 19.ii), 59 (1927).

Three transitional and nine typical male specimens have the discal area of the hind-wing more or less dusted with white: one aberration of the typical form in which the left fore-wing is crumpled has a patch of white on it.

Transition from *sidamona* to *oscari* proceeds by easy grades: it mainly reveals itself in the shape of the fore-wing which in *oscari* is more rounded than in *sidamona*. But at least one specimen shows the black spots intermediate in size also.

Ungemach seemed to find *oscari* rarer than did Hodson: he took it in both the centre and in Wallega.

Genitalia of *sidamona*, *oscari* and an intermediate are so similar that they must all be regarded as one species. The affinities of *oscari* with other forms of *zetes* appear to be with the *west* rather than with the east. The smaller subapical red patch on the fore-wing, with submarginal spots separated from the rest of the red area by a black border, and the spotted black border of the hind-wing are evidence of this. Also, on the under surface, the elongated submarginal orange spot in area 6 of the fore-wing agrees with *menippe* and *jalema* rather than with *acara*. On the other hand, the occasional white suffusion is only matched by *acara*. The significance of the simultaneous occurrence of *oscari* and *sidamona* in Abyssinia will be discussed later.

Acraea chilo Godm.

" Kilimanjaro; British East Africa; Somaliland and Abyssinia."

The claims for this species to be considered in this paper are just met by one of Erlanger's records, from Hulugo, on the upper part of the " Web " (Shebeli) River, just within the 1500 metre level. The locality given by Godman in his original description of the species as " Kalamet, Sebka Valley, Abyssinia 1868 " (Jesse) cannot be found on a map.

♀ form *crystalline* Gr. Sm. reported by Le Doux (1928) from Dire-Dawa.

Acraea insignis siginna Suff.

" German and British East Africa, especially in the high-lying localities."

Hodson. Males, 22. Females, 9. Locs. 32 (18.i), 33, 34, 35 (27.i), 36, 38, 44 (1927), 45 (1925), 50, 56 (1927), 63 (1927), 64 (10.i.27), 65 (15–29.xii.26, 3.i.27), 69, 70.

Three of the females (from loc. 45) have the areas which are usually red, of brownish red colour: in the rest the colour is red.

Ungemach found this species throughout Wallega to the Didessa: " la femelle est brun-orange terne."

Acraea neobule Dbl.

" South and East Africa to Angola, Rhodesia, Sudan and Abyssinia."

Acraea admatha Hew.

" Sierra Leone to Natal and British East Africa."

Hodson. Males, 3. Female, 1. Locs. 4, 19.

Acraea admatha Hew. f. *leucographa* Ribbe.

" Sierra Leone to Abyssinia and British East Africa."

Acraea iturina kakana Eltr.

" Abyssinia."

Hodson. Male, 1. Female, 1. Loc. 45 (1925, '27).

Ungemach only took this species at Oumbi: the extent of black varies greatly. He described ab. *infernalis* in which the hind-wing is black from the base to the outer limit of the line of post-median spots.

18

FIG. 18.—*Acraea iturina kakana* Eltr. S.W. Abyssinia, Meti Chafe, 4560 ft., 7.ii.27 (*A. W. Hodson*).

The genitalia of Hodson's male (fig. 18) was examined but nothing was found that would entitle *kakana* to specific rank, and until a series of preparations can be made from *iturina* and *kakana* showing specific difference they must be considered forms of one species. See Eltringham (1911, *Novit. zool.*, **18** : 151) who considers it " the Abyssinian form of *iturina*."

Acraea quirina F.

" Sierra Leone to British East Africa."
Hodson. Males, 3. Female, 1. Locs. 4, 19.

Pardopsis punctatissima Bdv.

" Cape to Somaliland, Uganda and Abyssinia."
Hodson. Males, 4. Locs. 20, 21, 22, 23 (3.x).

LIBYTHEIDAE.

Libythea labdaca Westw.

" Sierra Leone to Congo and Uganda, Kikuyu."
Hodson. One specimen from loc. 65 (14.xii).

Ungemach recorded " *laïus* Trim.," but it seems probable that the specimens are *labdaca*.

LYCAENIDAE.

Pentila nyasana ras Talbot (1935, p. 70).

Hodson. Males, 15. Females, 2. Locs. 4, 6, 11, 13, 14, 15, 19.

Aurivillius gave *nyasana* as a form of the widely spread *amenaida*, but in the collection of the British Museum it is regarded as a different species.

Lachnocnema bibulus F.

" Nigeria to the Cape Colony, East Africa and Uganda."

Ungemach found it in all the country traversed, from the Baro to Dire-dawa : the eastern specimens on the whole being smaller.

Lachnocnema brimo Karsch.

" Togo and Nigeria."
The British Museum possesses specimens from Dire-dawa.

Deudorix caerulea obscurata Trim.

" Ovambo district. Manicaland, Portuguese East Africa."
Ungemach took a single female at Bouré.

Deudorix baronica Ung.

Described by Ungemach as nearest to *dariaves* Hew., which occurs from Delagoa Bay to British East Africa, but smaller and without the sharply defined submarginal white band on the hind-wing, while the outer third of the wing is suffused with bluish white, and there is a yellow spot beside the black one on the anal lobe. The underside differs from that of *dariaves* and approaches that of *antalus*.

Deudorix dinochares Smith.

Transvaal, Mashonaland, East Africa.

A single male taken by Ungemach at Youbdo.

Deudorix dohertyi B.-B.

" British East Africa, Kikuyu."

Two males and a female captured at Touloudimtou are assigned " sans doute " to this species, by Ungemach.

Deudorix antalus Hpff.

Universal.

Hodson. Female, 1. Loc. 29 (24.iv).

Ungemach found it common and widespread.

Myrina ficedula Tr.

Angola to Cape Colony, and on east coast to Somaliland.

Recorded for Eritrea (Joannis & Verity, 1913), Adi-Ugri or Adi-Caiè.

Myrina silenus F.

" Sierra Leone to the northern Congo district, Uganda, Equatoria and Abyssinia."

Hypolycaena hatita Hew.

" Sierra Leone to Angola and Congo district."

Ungemach refers his specimens merely to the species : he found it common in Wallega and eastwards as far as Lekamti ; probably they are of the same form as Hodson's specimens.

Hypolycaena hatita ugandae E. M. Sharpe.

" Uganda, Kivu, Ukerewe."

Hodson. Males, 4. Locs. 54 (1925, '27), 56 (19.ii), 65 (31.xii).

Universal.

Hypolycaena philippus F.

Universal.

Hodson. Males, 3. Locs. 14, 19.

Ungemach found it common from the Baro to " Ouama, Orguessa, Lekamti."

Hypolycaena pachalica Btlr.

" German and British East Africa as far as Wadelai."

Hodson. Male, 1. Female, 1. Loc. 23 (6–8.x).

Ungemach took one male at Dire-dawa.

Stugeta bowkeri mombasae Btlr.

" British East Africa and Mombasa."

Hodson. Male, 1. Loc. 21 (25.iv).

Ungemach captured one male " à Bochè (bassin de la Guibbé) " which has not the red tint of the markings beneath, although it has the white ground-colour, characteristic of *mombasae*.

Argiolaus silas Westw.[1]

"Cape Colony as far as Delagoa Bay."

Ungemach took a freshly hatched male at Nole-Kaba, of the typical race and not the eastern *lalos*.

Argiolaus ismenias Klug.[1]

"Northern part of the Ethiopian region from Lagos to Nubia."

Two males and a female taken by Ungemach in the Didessa basin.

Argiolaus piaggiae Oberth.[1]

"Abyssinia."

The British Museum possesses a male from "Sadatcha Goma 5100 ft., 12.v.1905" and a female from "Dessa Kullo, 4200 ft., 24.vi.05" taken by Zapphiro.

Aphniolaus pallene Wallengr.[1]

"South West Africa, Transvaal, Natal and German East Africa."

Hodson. Male, 1. Female, 1. Locs. 23 (27.iv), 29 (24.iv).

Ungemach took one male at Billo.

Spindasis somalina Btlr.

"Somaliland."

One male and one female captured by Ungemach at Dire-dawa.

Spindasis banyoana B.-B.

The type is from Banyo, Cameroons.

Hodson. Males, 5. Locs. 21, 23 (4.x), 29 (24.iv), 48.

Axiocerses harpax F.

"Sierra Leone to Cape Colony and East Africa."

Hodson. Males, 3. Females, 2. Locs. 1, 11, 64 (10.i.27), 65 (27.xii).

Scott. Male, 1. Loc. Dj. (21–3.ix.26).

Ungemach found this widespread, and more common in the centre: the under surface considerably lighter than in the type.

This species was recorded by Joannis and Verity (1913), under the name *perion* Cram., as occurring in Eritrea at Adi-Ugri or Adi-Caiè.

Axiocerses argenteomaculata Pag.

"Abyssinia, near Burka."

Axiocerses amanga Westw.

"South West Africa, Matabeleland, Natal, Transvaal, Mashonaland, Nyasaland, German and British East Africa."

Hodson. Males, 3. Females, 2. Locs. 23 (3–5.x), 25 (29.iv), 29.

Axiocerses bambana Smith.

"East Africa."

Ungemach took a male on the Baro (in a locality from which *harpax* was absent) which he refers doubtfully to this little-known species on account of the absence of the silvery line near the margin of the hind-wing on the underside.

---

[1] Placed by Aurivillius in the genus *Iolaus* Hübn.

Leptomyrina boschi Strand.

" Abyssinia."

Ungemach found this only in the centre, " dans les bassins du Goudder et du Haut Aouache," where it is common. The general colour is " brun foncé chez le ♂ et brun gris chez la ♀ " rather than the " gris cendré clair " of the type.

Leptomyrina lara L.

" South and East Africa from the Cape Colony to Kavirondo and Abyssinia."

Spalgis lemolea H. Druce.

West Africa from Senegambia to Rhodesia, Uganda, and Kavirondo.

Ungemach found this not very common but widely distributed in the west, including Baro and the Didessa basin. The specimens have a wider sprinkling of grey-black at the bases of the wings than those from West Africa.

The next group of species has been assigned by all recent writers to the genus *Lycaenesthes* Moore, but Mr. Francis Hemming informs me that this name should be replaced by the name *Anthene* Doubleday. The reason why this change is necessary is explained by Mr. Hemming in Appendix 1 (see p. 435).

Anthene wilsoni Talbot.

Hodson. Female, 1. Loc. 23 (28.iv.25).

This species, recently described by Talbot (1935, p. 121–2) is named after Lt.-Col. R. S. Wilson who captured two specimens in the Southern Sudan (Nuba mountains) in 1917–18 and generously presented them, with many other species from the same interesting area, to the Oxford University Museum.

Anthene musagetes Holl.

" Sierra Leone to Angola and Uganda."

Hodson. Males, 2. Locs. 34, 51.

These are in poor condition. They resemble a specimen in the Joicey collection from Hoey's Bridge, Kenya Colony.

Ungemach took *musagetes* once at Bouré.

Anthene saddacus Talbot.

Recently described from Lake Saddaca, and Hodson's loc. 37 (Talbot, 1935 : 123).

Anthene ligures Hew.

" The whole of West Africa from Sierra Leone to Angola, and to the East as far as Nandi and Kilimanjaro."

Ungemach took, in Wallega and as far east as the Alenga, numbers of a form which he ascribed doubtfully to this, and which certainly are not *liguroides* ; they are characterised by the shape of the basal spot in area 7 on the underside of the hind-wing which forms a transversely elongated triangle with the point lying on the disco-cellular nerve instead of being rounded.

The insect taken near Eli in Abyssinia which Strand named *liguroides* is presumably referable to this species.

Anthene aurobrunnea Ung.

Quite common in the centre, even at Addis Ababa, and more rarely in Wallega. Abundant at Lekamti.

The male of this species has the fore-wing entirely brilliant brown with a golden reflection and an extremely narrow blackish border: hind-wings of the same colour except around the ocelli where there is a blue reflection. The under surface shows a discal band on the fore-wing and the median band of the hind-wing meeting each other so as to be continuous: the band on the anterior wing has sharp edges absolutely parallel and without a break from vein 2 to the costa.

The female resembles the male but the golden brown is lighter and warmer.

Anthene aurobrunnea Ung. ♀ f. *coelestina* Ung.

Three females, captured at Lekamti, have the posterior wings sky-blue up to the golden brown border, and the anterior wings are sky-blue from the base to just beyond the middle.

Anthene contrasta Ung.

A species occurring rarely in the centre and once captured at Bedellé on the edge of Wallega. The male is deep brown with a deep violet reflection over parts of both wings: the underside has the pattern much more sharply cut than in other species of *Anthene*. The female is like the male but the reflection is bluer and less sharply defined.

Anthene definita Btlr.

" South and East Africa from Cape Colony to British East Africa and Uganda."

Hodson. Males, 3. Locs. 28, 54, 56 (19.ii).

Scott. Male, 1. Female, 1. Loc. Dj. (21–3.ix.26).

Ungemach described a species under the name *fasciata*, but the name is already pre-occupied by *fasciata* Auriv. = *subnitens* B.-B. I am indebted to M. Ungemach for sending me a specimen of his *fasciata* which has been compared by Mr. G. Talbot with the long series of *definita* in the British Museum. It appears that the distinction which Ungemach drew between his specimens and *definita* cannot be maintained; it is, however, interesting that the colour of the upper surface of the *fasciata* is like that of the type of *definita* which comes from South Africa, of a darker or browner purple than other specimens from Abyssinia taken by Hodson and Scott. The large area over which *definita* ranges results in considerable variation, especially in the development of the spots in the female.

Anthene indefinita B.-B.

" British East Africa; Uganda; Ruwenzori."

Hodson. Males, 7. Locs. 34, 50, 60, 63 (1925), 65 (24.xii).

Anthene sylvanus Drury.

" Sierra Leone to Angola."

Cannaviello (1902) recorded three specimens, male and female, from Adi-Caie and Adua in Eritrea. But the record is doubtful since he remarked that the specimens " do not correspond to the description of Drury. I observe in them a more intense general colour and the spots thicker and darker." Bethune-Baker gave the distribution as including Northern Nigeria and Volta River, but was " unable to trace it into Central, South, or East Africa."

Anthene otacilia kikuyu B.-B.

"Near Kikuyu, British East Africa."

Hodson. Male, 1. Loc. 14.

Ungemach found it not uncommon in the centre, very scarce at Youbdo.

Anthene hodsoni Talbot.

Recently described by Talbot (1935, pp. 125–6).

Males, 4. Loc. 29 (28.ix.25).

Anthene suquala Pag.

"Abyssinia, Suquala."

The identity of this "species" described from a badly worn specimen cannot be determined: I have attempted to trace the whereabouts of the type but without success: the description is inadequate.

Anthene gemmifera Neave.

"Rhodesia."

To this species belong the specimens which Ungemach figured and described as *Monile pluricauda.* I am indebted to Mr. G. Talbot for suggesting this, and took one of Neave's two specimens to compare with the type of *pluricauda* in M. Ungemach's presence. The name *Monile pluricauda* therefore falls. One male and one female were captured by Ungemach on a tributary of the river "Ouama."

Anthene princeps Btlr.

"Sierra Leone to Natal and Abyssinia."

Ungemach took this commonly in Wallega on the Didessa and up to the centre.

Anthene livida Trim.

"Cape Colony to Abyssinia."

Hodson. Female, 1. Loc. 21 (30.ix).

Anthene lunulata Trim.

"Sierra Leone to Angola, Mashonaland and Mombasa in British East Africa."

Hodson. Male, 1. Loc. 29 (24.iv).

Ungemach found this species, of which *hewitsoni* Auriv. is a synonym, very widespread and often abundant.

Anthene amarah Guèr.

Universal.

"One of the commonest butterflies of Abyssinia" (Ungemach).

Anthene larydas kersteni Gerst.

"Chiefly in South and East Africa."

Ungemach ascribes his specimens of *larydas* to the eastern race and notes its great abundance everywhere.

Anthene rothschildi Auriv.

Described by Aurivillius (1922) from "Ethiopie, Koulala."

Anthene crawshayi Btlr.

" Sierra Leone to Uganda."

Hodson. Males, 4. Locs. 33, 35, 50, 54.

Ungemach reported this common everywhere, approaching the form *parallela* Auriv.

♀ form *albilunata* is described as " avec une bande brun-gris submarginale, limitée vers l'intérieur par une ligne de croissants blancs."

Anthene phoenicis Karsch.

" Sierra Leone to Uganda and Rhodesia."

Hodson. Female, 1. Loc. 62.

Anthene lusones Hew.

" Sierra Leone to Angola."

Cannaviello (1902) gave a record of this from Adi-Ugri and Adua in Eritrea, under the name *Lycaena fulvimacula* Mab., but remarked that the two specimens (♂ ♀) " differ pretty much from the described type and figured by Mabille which lives at Zanzibar and at Madagascar. . . . I consider this form as a well distinct local variety." The difference, given in peculiar English, appears to be that the bases of the wings are suffused with blue instead of being quite black; the grey spot of the primaries is distinctly triangular instead of being round; the white bands on the underside of the hind-wings are more angular and in one specimen slightly blue, the anal spot is larger and dark blue in the middle while in specimens from Zanzibar it is black.

It seems doubtful if the record can be trusted, since the species is not recorded from Zanzibar by Bethune-Baker in his revision but has a truly West African distribution.

Uranothauma antinorii Oberth.[1]

Abyssinia and East Africa, Rhodesia, Cameroons.

Hodson. Males, 15. Locs. 32 (24.ix; 18.i), 50 (22.ii), 54, 56 (7, 10, 19.ii), 63 (1925), 64 (31.i.27).

Ungemach found it very rare : he took one female on the Goudder which has a pattern like that of *falkensteini* female but brownish black on a light grey base. An intense sky-blue reflection is seen at the base of areas 1*b*–2 on the anterior wing up to the discal band. Under surface like that of the male.

Scott. Female, 1. Loc. Dj. (21–3.ix.26). This agrees with the specimens described by Ungemach, which must be considered the typical female : the commonest form, however, appears to be *albicans* Talbot, which is not known, as yet, from Abyssinia (Talbot 1935).

Uranothauma nubifer Trim.[1]

Natal, East Africa, Cameroons.

Hodson. Males, 3. Locs. 39 (1925), 54.

Scott. Males, 3. Loc. Dj.–A.

Ungemach found it common, but the female (as seems usual in this section) was reported as " relativement très rare."

ab. *distinctesignatus* Strand. Described from " Eli, Abyssinia," but occurs also on Ruwenzori and Kilimanjaro according to Aurivillius.

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Uranothauma falkensteini Dew.[1]

" Sierra Leone to Angola and British East Africa."

Hodson. Males, 21. Locs. 28, 32 (21–22.i), 34, 35, 39, 46, 47, 54, 56 (7.ii.25), 63.

Scott. Males, 2. Locs. Dj.–A., Zq. (25–27.x).

Ungemach reports it as less common than *nubifer* but not rare in the whole of Wallega. No *Uranothauma* reaches the Baro.

Cacyreus lingeus Cr.[1]

Universal.

Hodson. Males, 13. Females, 4. Locs. 27, 28, 32 (18–22.i.25), 34, 35, 39 (7.iii) 65 (7–11.xii).

Scott. Males, 2. Females, 2. Locs. Dj. (7–9.x), K., Zq. (25–27.x).

Ungemach in his account, by a slip, put *palemon* for *lingeus* and *marshalli* for *palemon*. Having queried the presence of the South African *marshalli* in Abyssinia, I was requested by M. Ungemach in a letter to rectify the error in this paper, and do so accordingly. *C. lingeus* was found widespread in the centre, Wallega and on the Didessa.

Cacyreus palemon ghimirra Talbot.[1]

In its nominotypical form, this species occurs in " South and East Africa to Ruwenzori." The Abyssinian race has recently been described as *ghimirra* Talbot (1935 : 148).

Hodson. Males, 22. Females, 8. Locs. 26 (16.iv), 32 (18–22.i), 34, 35, 37, 39 (March), 55, 56 (7.ii.25), 65 (18, 22.xii).

Scott. Males, 3. Females, 3. Locs. Dj. (7–9, 21–23.ix), C. (22.xi), Zq. (25–27.x).

Ungemach. Much rarer than the last, but widespread.

Tarucus sybaris Hpffr.[1]

" Cape Colony and the whole of East Africa as far as Somaliland and Abyssinia."

Tarucus grammicus Gr. Sm.[1]

East Africa and Somaliland.

Ungemach recorded it as confined to the centre passing little west of the Didessa.

Tarucus theophrastus F.[1]

Hodson. Males, 3. Locs. 16, 18, 29 (April).

Aurivillius wrote : " All the specimens of '*theophrastus*' from the Ethiopian region, which I have seen, belong to *mediterraneae*."

Tarucus mediterraneae B.-B.[1]

Nubia, Khartum, Kordofan, Adamaua.

Hodson. Male, 1. Loc. 17 (Oct.).

Ungemach did not find it in " Abyssinie propre " : it occurred on the Baro and at Dire-Dawa. One male had a black border of 1·5 mm. like that of *Syntarucus plinius* ab. *marginalis* Auriv.

Castalius hintza resplendens Btlr.[1]

" Abyssinia."

This record appears to rest on Butler's paper (1876) on specimens from

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Atbara which he thought was in Abyssinia. According to Aurivillius the species is a South African one, not coming further north than Rhodesia: but Mr. T. H. E. Jackson has presented to the Oxford University museum a specimen of *hintza* taken by him on the south-east slopes of Elgon.

Castalius ertli ertli Auriv.[1]

" Nyasaland."

Ungemach recorded this as very abundant throughout Wallega and going as far east as the Alenga. But it is probable that the specimens belong to the following, described by Talbot.

Castalius ertli kaffana Talbot.[1]

A race recently described by Talbot (1935 : 149).

Hodson. Males, 27. Females, 2. Locs. 11, 32 (18–25.i.25), 33, 34, 35, 39, 49, 50, 51, 52, 54, 55, 56, 64 (15.ii.25, 11.i.27).

Castalius cretosus cretosus Btlr.[1]

" The typical form originates from Abyssinia."

Hodson. Male, 1. Loc. 23 (4.x).

Ungemach took a single male on the Baro.

Castalius cretosus lactinatus Btlr.[1]

" Somaliland and Kordofan."

Ungemach found it abundantly at Dire-Dawa. He pointed out that neither of the races of *cretosus* occur " en Abyssinie propre " : it seems to be replaced there by *C. ertli kaffana.*

Castalius isis Drury.[1]

" Sierra Leone to Angola, Uganda and Equatoria."

Ungemach found it localised and rather rare in the west from the Baro to the Guibbé.

Azanus natalensis Trim. 1887.

" Natal to Abyssinia, Ruanda, and French Congo."

Hodson. Males, 2. Female, 1. Locs. 26 (10.ix), 67, 68.

Scott. Male, 1. Loc. W.

Ungemach. Abundant wherever Acacias grow.

Azanus moriqua Wallengr.[1]

" Angola to Natal and Delagoa Bay, also on L. Tchad."

Taken by Donaldson Smith in the country north of L. Rudolf (Sharpe 1896). Recorded by Aurivillius (1922) from Lake Abbai and found common by Ungemach in the west from the Baro to the Guibbé. The type of *sigillatus* Butler, which is in the British Museum, is a specimen of *moriqua* Wallengren.

Azanus jesous Guèr.[1]

Whole of East and South Africa as far as mouth of Congo.

Hodson. Female, 1. Loc. 29 (28.ix).

Scott. Male, 1. Loc. Zw. (5–7.xi).

Ungemach found it replacing the last-mentioned species in the east and centre, and never occurring with it.

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Azanus mirza Plötz.[1]

Sierra Leone to Nyasaland, East Africa, Natal.

This species, of which *occidentalis* Butler is a synonym, was recorded by Aurivillius (1922) from " Ethiopie, Moullou."

Hodson. Males, 2. Female, 1. Locs. 3, 23 (3.x), 51 (3.ii).

Azanus ubaldus Cr.[1]

" Cape Colony to Somaliland and Nubia, Arabia."

Widespread but never abundant, according to Ungemach.

Syntarucus plinius F.[1]

" Universal."

Hodson. Males, 36. Females, 3. Locs. 17 (28.x), 19, 24, 27, 28, 32 (24.ix, 18–27.i), 35, 39 (7.iii), 40, 56 (7, 19.ii), 65 (9.xii), 66.

Scott. Males, 4. Locs. K. (5.xi), Zw.

Bullock. Males, 2. Locs. L. (8.i).

Ungemach found it one of the commonest Abyssinian butterflies : one specimen from Youbdo was of the rare aberration *marginalis* Auriv.

Syntarucus pulchra Murray.[1]

Recorded by Sharpe (1896) in Donaldson Smith's captures from north of L. Rudolf. Specimens in the British Museum come from Lower Nigeria, British East Africa, and the Victoria Falls.

Nacaduba sichela Wallengr.[1]

" Sierra Leone to Cape Colony and East Africa, also in Madagascar."

Scott. Female, 1. Loc. Dj. (23.ix).

Ungemach said it is common in the east from the Baro to the Guibbé : is not found in the east centre but occurs at Dire-Dawa.

Cosmolyce boeticus L.[1]

Universal.

Hodson. Males, 25. Females, 4. Locs. 17 (28.x), 19, 24, 27, 32 (24.ix, 18–27.i), 33, 34, 35, 39 (7.iii), 40, 56 (7, 19.ii), 65 (9.xii), 66.

Scott. Males, 3. Females, 2. Locs. Dj. (7–9.x), K.

Ungemach found it very common.

Lepidochrysops peculiaris Rogenh.[1]

Rhodesia, Nyasaland, Manicaland, British East Africa.

Cannaviello (1902) recorded three specimens (♂♀) from Godofelassi in Eritrea under the name of *Catochrysops perpulchra* Holl.

Lepidochrysops asteris Godt.[1]

" Cape Colony to Natal."

E. M. Sharpe (1896) included this among the species captured by Donaldson Smith north of L. Rudolf. The present whereabouts of the specimen being unknown (it is not in the British Museum) a revision of the diagnosis is impossible, but it is unlikely that it would be confirmed since the known distribution of *asteris* Godt. is so very southern.

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Lepidochrysops pterou lilacina Ung.[1]

Described by Ungemach from specimens found abundantly in the Didessa valley. The male, grey-lilac, has a black margin to the fore-wings reaching a width of 1·5 mm. before the apex: the posterior wings are definitely lighter along the outer margin and whitish around a small black spot in area 2. The submarginal band on the under surface of the anterior wing is not interrupted as in *p. pterou.* The female has a large discal spot and the marginal band of 3 mm. width interrupted at its middle, in areas 1*b* to 3 by a soft whitish line.

C. p. pterou is described from Kavirondo, Kenya Colony.

Lepidochrysops cinereus lunulifer Ung.[1]

Found by Ungemach in the Didessa basin, this form differs from *c. cinereus* of N.W. Rhodesia by the following. The posterior wing on the upperside has an indistinct line of whitish lunules. Underneath the discal spot in 1*b* on the anterior wing is displaced outwards so that its white frame is continuous with that of the next spot. Female unknown.

Lepidochrysops parsimon oculus Ung.[1]

Ungemach described an Abyssinian race, near to *kivuensis* J. & T., widely distributed in the Didessa and Guibbé basins and once found in Wallega. The male differs from *p. parsimon* F. by the large and very black ocellus on the hind-wing being surrounded by a pale yellow elliptical spot on the upper surface. The female has the bases of the wings darkened instead of being paler, and can be distinguished from *p. kivuensis* by a large black marginal band on the anterior wing which is not divided by a thin pale submarginal band.

Lepidochrysops polydialecticus B.-B.[1]

" East Africa : Kadugli, Ullal, Kibwezi."

Hodson. Males, 3. Female, 1. Locs. 22, 23 (2, 3, 8.x).

Lepidochrysops patricius Trim.[1]

" Cape Colony to Abyssinia."

Lepidochrysops negus B.-B.[1]

" Abyssinia : Bogos. Nairobi."

Lepidochrysops subvariegatus Talbot.[1]

Described from a male in the British Museum taken by R. E. Drake-Brockman at Dire-Dawa, 23.vii.1908 (Talbot, 1935 : 150).

Euchrysops barkeri B.-B.[1]

" Sierra Leone, Congo, Angola, Natal to German East Africa, Rhodesia, Ruwenzori."

Hodson. Females, 2. Locs. 19, 23.

Ungemach found it very rare : one male from Bouré, one from the Didessa.

Euchrysops mauensis B.-B.[1]

Kenya Colony, Mau Escarpment.

Specimens captured between the Didessa and the Guibbé by Ungemach have the sub-basal spots on the underside of the hind-wing brown instead of black.

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Euchrysops albistriatus Capr.[1]

" Sierra Leone, Congo District, Uganda."

Common in the Didessa basin and Wallega. Ungemach described the female as very like that of *cissus* Godt. but with a large blackish disco-cellular spot: the marginal orange spots of the underside are better developed than in the male.

Euchrysops malathana nilotica Auriv.[1]

" River Nile near Kaka."

Hodson. Males, 8. Females, 5. Locs. 1, 3, 15, 21 (15.iv), 23 (2.x), 33, 35, 69.

Scott. Males, 7. Females, 2. Locs. C. (18.xi), K., Zq. (25–27.x).

Ungemach found this form chiefly on the Baro in May and at Dire-Dawa in July but also in the centre in February. The species was extremely common.

Euchrysops reducta niveocincta Ung.[1]

This form differs from the type by the lighter colour underneath.

Euchrysops osiris Hpffr.[1]

Universal.

Ungemach describes his specimens as of the typical form: widely spread but never abundant.

Euchrysops osiris Hpffr. f. *brunneus* B.-B.[1]

" British East Africa: Nairobi."

Hodson. Males, 8. Females, 3. Locs. 11, 15, 16, 17, 23 (2, 3.x), 29, 55.

Bullock. Female, 1. Loc. L. (7.i.25).

Euchrysops cyclopteris Btlr.[1]

" Abyssinia " [*sic*].

This is another record from Atbara (Butler 1876) which is *not* in Abyssinia. This species cannot be included in an Abyssinian list until further evidence is to hand.

Euchrysops abyssinicus Auriv.[1]

Abyssinia: Tchafianani Dabasso.

Euchrysops antoto Strand.[1]

" Abyssinia: Antotos."

Euchrysops elicola Strand.[1]

" Abyssinia: Eli."

Euchrysops pusillus Ung.[1]

Three specimens taken at " Toké " (2 males) and " Ouolota " (1 female) are discussed by Ungemach as possibly *antoto*, but the description of the latter is inadequate: the locality Antoto or Entoto is not more than 40 kilometres from Ouolota. But Ungemach's specimens have the under surface of the fore-wing of a pattern very abnormal for a *Catochrysops* sens. lat. and are probably different from those described by Strand, who does not mention peculiarities of the fore-wing.

Euchrysops eleusis Demais.[1]

" Senegal, Nubia, Abyssinia."

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Euchrysops distractus Joann.[1]

" Abyssinia " (Eritrea). Exact locality not given.

Euchrysops masai B.-B.[1]

" British East Africa (Kikuyu)."

Scott. Male, 1. Loc. Zq. (25–7.x).

Eicochrysops messapus Godt.[1]

" Cape Colony, Kaffraria, Abyssinia."

Ungemach took a long series of specimens from Addis Ababa to the western limit of Wallega, and considered that the variations show that *messapus* Godt., *mahallakoaena* Wallengr., *trisignatus* Strand, *sebagadis* Guér. and *nandianus* B.-B. are conspecific.

Freyeria trochylus Freyer.[1]

South and East Africa, Abyssinia, Nubia, Arabia, Sokotra.

Hodson. Male, 1. Female, 1. Locs. 21, 57.

Scott. Male, 1. Loc. K.

Ungemach found it only in the Somali part of Abyssinia (Awash station Gotha, Dire-Dawa).

Cupidopsis cissus Godt.[1]

Universal.

Hodson. Males, 12. Female, 1. Locs. 26 (31.iii, 10.ix), 28, 32, 34, 65 (16, 18.xii), 66.

Found commonly by Ungemach in the centre as well as Wallega.

At Toukour, at a high elevation in the centre, he took a series of the form *catharina* Trim., the underside is beige instead of pearl-grey, the orange spots are pale, the spots on the hind-wings grey instead of black. Perhaps a " winter " form, taken in October.

Cupidopsis jobates Hpff.[1]

Angola, South Africa, East Africa to Abyssinia.

Ungemach separated a race *uranochroa* characterised by a brighter and more extended blue in the male since there is no marginal band on the posterior wing and it is not more than 1 mm. wide on the anterior. The female has bluish-grey spots in areas 3, 4, 5 on the hind-wing. This form was taken " à l'extrême limite de l'Abyssinie " at the confluence of the Baro and the Pibor (Gilo) rivers, on the Sudan frontier, and is therefore outside the 1500 m. limit.

Everes hippocrates F.[1]

" Sierra Leone to Natal and Abyssinia."

Hodson. Males, 2. Locs. 56 (19.ii), 65 (9.xii).

Scott. Male, 1. Loc. D. (18–20.x).

Ungemach found it extremely common from the Baro to the eastern limit of Abyssinia proper.

Everes micylus colorata Ung.[1]

Ungemach described a form of *togara*, which, from the description, was considered by Mr. G. Talbot to be more probably *micylus*. M. Ungemach very kindly sent me a specimen which enabled Mr. Talbot to confirm his diagnosis that the form *colorata* belongs to *micylus*. The account of these species given by Aurivillius in " Seitz " is unsatisfactory. The form was captured only at Youbdo and on the Didessa.

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Oboronia punctatus Dew.[1]

" Nigeria."

Hodson. Male, 1. Loc. 44 (1925).

Oboronia gussfeldti Dew.[1]

" Sierra Leone to Angola."

Hodson. Male, 1. Loc. 35 (25.i).

Athysanota elorea F.[1]

This species, of which *ornata* Mab. is a synonym, was described from Sierra Leone.

Hodson. Male, 1. Loc. 36.

Zizeeria gaika Trim.[1]

Most of Africa.

Hodson. Males, 18. Female, 1. Locs. 27, 32 (18–22.i), 33, 35, 36, 38, 57 (2.ii).

Scott. Males, 9. Female, 1. Locs. D. (18–20.x), K. (5.xi), Zq. (25–7.x), Zw. (26.xi).

Ungemach found it common, but absent from the centre.

Zizeeria antanossa Mab.[1]

Most of Africa.

Hodson. Male, 1. Loc. 23 (2.x).

Scott. Male, 1. Loc. K.

Ungemach recorded that it replaces *gaika* in the centre where it is common, but much rarer in Wallega.

Zizeeria lysimon Hbn.[1]

Universal.

Hodson. Males, 15. Locs. 18, 26 (16.iv), 32 (22.i), 34, 35, 36, 57 (2.ii), 60, 69.

Scott. Males, 4. Locs. D. (18–20.x), K., Zw. (6–7.xi).

Ungemach. Extremely common everywhere.

Zizeeria lucida Trim.[1]

" South Africa from Angola to Cape Colony and from there in East Africa British East Africa."

Rare, and found by Ungemach only at Youbdo.

Actizera stellata Trim.[1]

" Cape Colony, Nyasaland, Kilimanjaro."

Hodson. Female, 1. Loc. 26 (10.iii).

Ungemach. Widely spread and often abundant.

Lycaena phlaeas pseudophlaeas Lucas.

" Abyssinia."

Hodson. Males, 2. Females, 3. Locs. 26 (31.iii), 32 (18.i), 37, 65 (18.xii).

Bullock. Male, 1. Loc. Ab.

---

[1] Placed by Aurivillius in the genus *Cupido* Schrank.

Ungemach found it as common in open parts in all the typically Abyssinian country as our European form, but not on the Baro or in the Somali country.

HESPERIIDAE.

The arrangement of HESPERIIDAE made by Aurivillius in "Seitz" has been criticised by Brigadier W. H. Evans, who has been engaged in revising the collections in the British Museum, and kindly gave great assistance to me in connection with the Abyssinian records. He wrote: "Aurivillius departed from the arrangement founded by Watson 1893 and followed by Holland 1896, Mabille 1904 and in all other volumes of the 'Macrolepidoptera': it does not seem desirable to continue Aurivillius' departure from a generally accepted system for some reason which he did not explain."

The six species with which the present list opens, were placed in the genus *Rhopalocampta* Wallengren, by Aurivillius and have been so treated by other authors who have dealt with this group. Mr. Francis Hemming informs me, however, that this name is invalid and that it should be replaced by the name *Coeliades* Hübner. In Appendix 1 (p. 436) Mr. Hemming explains why this change is necessary.

Coeliades chalybe immaculata subsp. n.

Hodson. Male, 1. Female, 2.

Resembles *C. chalybe* Dbl. in every way except that there is no trace of the white marking on the underside of the hind-wing.

Male type from loc. 41. Females, locs. 2 (the allotype) and 6.

The typical form of this species is West African extending to L. Victoria.

Coeliades forestan Cr.

Universal.

Hodson. Males, 19. Females, 3. Locs. 4, 12, 23 (9, 11.x), 34, 50, 53, 56 (26.i), 60, 64 (4.i), 65 (15.xii–4.i, 12.i).

Ungemach found it common but scattered in distribution.

Coeliades anchises Gerst.

"East Africa from Delagoa Bay to Somaliland, and near Aden."

Aurivillius (1922) recorded it from "Ethiopie, Haut Aouache."

Taken by Ungemach at Dire-Dawa only. Specimens are in the British Museum from Dire-Dawa and Toma.

Coeliades pisistratus F.

Sierra Leone to South Africa but unknown to Aurivillius from north of Delagoa Bay.

Hodson. Males, 3. Locs. 23 (3, 11.x).

Coeliades hauno Plötz.

"Sierra Leone to Gabun."

Hodson. Male, 1. Loc. 6.

Plötz described the ♀ of this species in 1879 under the name *hanno* and the ♂ in 1884 under the name *necho*.

Coeliades menelik Ung.

Allied to *keithloa*, but linked to this South African species by forms occurring in East Africa. Ungemach took a single specimen at Lilmo in the Sayo country at the edge of the Sudan.

Chondrolepis niveicornis Plötz.

“ Angola, Rhodesia, Kaffraria, Nyasaland, Kilimanjaro.”

Cannaviello (1902) recorded this from Adi-Ugri, Eritrea, under the name of *Pamphila murga* Mab.

Hodson. Male, 1. Loc. 14.

Ungemach found it abundant at Youbdo, but took it nowhere else.

Andronymus philander Hpff.

“ Togoland to Angola ; Portuguese E. Africa.”

A single specimen taken by Ungemach at Youbdo.

Pardaleodes incerta Snell.

‘ Congo district as far as Ruwenzori and the Rutchuru plains.”

Hodson. Male, 1. Females, 2. Locs. 14, 15 (23.ii).

Ungemach took it scattered in Wallega and the Didessa valley.

Pardaleodes herilus Hpff.

“ Portuguese and German East Africa.”

Taken at Youbdo only, by Ungemach.

The next species to be dealt with was called *Padraona zeno* (Trimen) by Aurivillius in Seitz’s *Grossschmett. Erde.* It cannot, however, be referred to the genus *Padraona* Moore (which is a synonym of *Potanthus* Scudder), and Brigadier W. H. Evans informs me that it is at present without a valid generic name. He has accordingly been kind enough to prepare the following diagnosis of a new genus for the reception of this species :—

Zenonia gen. n. Evans.

> Antennae $\frac{9}{17}$ costa : club stout : apiculus abrupt from end of club, fine, upturned, shorter than the width of the club. Palpi short, semi-erect : third segment short, and in continuation of second, which is not flattened. On the fore-wing, vein 2 arises nearer to the lower end of the cell than the base : vein 5 decurved, and the upper end of cell produced. On the hind-wing the end of the cell is straight, and its lower angle is bent up : the origin of vein 5 is nearer to the origin of vein 6 than to that of vein 4 : vein 1A longer than vein 2 : termen excavated at end of vein 2. The genitalia, venation and antennae resemble those of the genus *Baoris* Moore : the palpi and facies recall *Pardaleodes* Butler. Superficially there is a close resemblance to *Potanthus* Scudder (*Padraona* Moore) in which genus the genotype has been placed by Aurivillius and other Authors : the palpi and genitalia, however, are very different.
>
> GENOTYPE : *Zenonia zenonia* (Trimen, 1864) (= *Pamphilia zenonia* Trimen, 1864). [W. H. EVANS.]

Zenonia zeno Trim.[1]

“ South Africa to Angola ; whole of East Africa to Mt. Elgon.”

Hodson. Males, 3. Females, 2. Locs. 26 (8.ix), 56 (10, 15, 17.xii, 4.i).

Ungemach found it widespread and common.

There are specimens in the British Museum from “ Abu Kassa and Mt. Abu Kassim ” (Drake-Brockman 1908). “ Charada Forest, 6000 ft.,” and “ Kindo Djuna ” (Zaphiro 1905).

---

[1] Placed by Aurivillius in the genus *Padraona* Moore.

Baoris fatuellus Hpff.[1]

" Sierra Leone to South and East Africa."

Found abundantly by Ungemach at Gambela and Youbdo.

Baoris fatuellus Hpff. f. *caffraria* Plötz.[1]

The name *cinerea* Holland can be used for the dry-season form which Aurivillius called form *fatuella.* Specimens in the British Museum come from " Ala Balla " (Degen 1902) and " charada Kaffa, 6000 ft." (Zaphiro 1905).

" Cameroons to South and East Africa."

Widely spread in the centre, Wallega, and on the Baro.

Pelopidas micans Holl.[1]

" Ogowe Valley across Central Africa to British East Africa."

A rare species found singly on the Baro and in two places in Wallega.

Pelopidas borbonica senegalensis Klug.

Universal.

Hodson. Males, 5. Female, 1. Locs. 13, 23 (3, 8.x), 39 (7.iii), 40.

Only found in three widely separated localities (Baro, Djemdjem, Gotha) by Ungemach.

Pelopidas ferruginea Auriv.[1]

" Dar-es-Salaam."

Ungemach found it quite widely spread in all the west and up to the Guibbé.

Pelopidas holtzii Plötz.[1]

" Mashonaland and East Africa."

Common on the Baro and in Wallega. *Parnara aures* Mab. is a synonym of this species.

Pelopidas noctula Ham. Drc.[1]

One specimen taken by Ungemach at Youbdo. The two males and one female in the British Museum come from Cameroons and Uganda.

Evans looks upon the identification of Ungemach's specimen as incorrect, since *noctula* is a frequenter of areas of heavy rainfall. But it occurs in Uganda, and Ungemach mentioned the locality as heavily forested, and at an altitude of only 1600 metres.

Pelopidas detecta Trim.[1]

Aurivillius placed *auritincta* Btlr. as separate from *detecta*, but Evans considers them to be conspecific.

" Natal to Kilimanjaro."

Hodson. Males, 4. Females, 4. Locs. 4, 11, 14, 15, 19, 23 (6, 11.x).

One specimen from loc. 15 has a very clear imprint of a bird's beak on the wing.

Ungemach found *detecta* (= *auritincta*) widespread, as far as Dire-Dawa except on the Baro.

Specimens in the British Museum come from " Dissakulla, 4200 ft." (1905), and " Abobo, Akobo river 1904, Lake Rudolph Expedition," captor Zaphiro : " Dirre-Daoua " (Drake-Brockman, 1908).

---

[1] Placed by Aurivillius in the genus *Parnara* Moore.

Pelopidas mathias F.[1]

Evans finds two distinct species confused under *mathias*: some specimens (*e.g.* a male taken by Drake-Brockman, "Schebeli 1894," locality probably below the limit now under consideration) being *P. thrax* Hübner.

Universal.

Hodson. Males, 7. Females, 4. Locs. 10, 11, 14, 18, 23 (3, 7, 8, 10.x), 37, 65 (25.xii).

Ungemach found it the most abundant species in Abyssinia of what he called "*Parnara.*"

Pelopidas gemella Mab.[1]

Madagascar, Mafia, Juan de Nova islands.

Specimens in the British Museum show its range to cover also the Seychelles, Aldabarah, Senegal to Angola, Natal, Mozambique, Kenya, Uganda.

Hodson. Males, 2. Females, 2. Locs. 14, 17 (26.x), 23 (14.x), 40.

Gegenes letterstedti brevicornis Plötz.

"East Africa to Ruwenzori and Elgon."

Hodson. Males, 8. Females, 2. Loc. 32 (24.i.x, 18, 21.i), 60, 65 (12.xii), 69.

Scott. Males, 3. Females, 5. Locs. C., D. (18–20.x), Dj. (21–23.ix).

Ungemach found it very common in the centre, in Wallega, and at Youbdo. This species was mis-identified with *niso* L., by Aurivillius.

Gegenes obumbrata Trim.

Scott. Males, 2. Females, 3. Locs. C. (14–15.xi), D. (18–20.x), Zq. 25–27.x).

This species has often been treated in the past as a subspecies of *niso* L. The identity of *Papilio niso* L. has been carefully examined by Evans, who has kindly furnished me with the following note:—

> "Aurivillius (1882) and (1925) considered *niso* to be the ♀ of *letterstedti* and *hottentota*. Trimen (1889) and Holland (1896) could not accept Linnaeus' name. Aurivillius (1889) published a copy of Clerck's unpublished figure of *niso*, which neither resembles Linnaeus' description nor, even remotely, any known African Hesperiid. Linnaeus' description does not conform with any known species of *Gegenes* and comes nearest to *Baoris fatuellus* (Hopffer). For the above reasons I treat *niso* as a rejected name. *Gegenes hottentota* (Latreille) is a species confined to South Africa and is quite distinct from *Gegenes letterstedti*. The present species should stand as *Gegenes obumbrata* (Trimen). It has no synonyms."

Ungemach recorded this species as very rare but as occurring with the preceding species at the same time.

Kedestes macomo Trim.

"South Africa to Delagoa Bay."

Hodson. Female, 1. Loc. 23 (8.x).

Kedestes wallengreni Trim.

"Natal, Mashonaland, Kilimanjaro."

One male taken by Ungemach at Nolé Kaba.

---

[1] Placed by Aurivillius in the genus *Parnara* Moore.

Isoteinon punctulata Btlr.[1]

" Congo district, and on Lake Tanganyika."

Ungemach took one male on the Baro in which the crescentic marginal spots were missing, but between the nerves there were sharply defined round white spots. The specimen was submitted to Mr. N. D. Riley of the British Museum (Natural History) for identification.

Metisella midas Btlr.[2]

" Nyasaland."

Not uncommon and widespread through Wallega.

Specimens in the British Museum come from Buar in the Cameroons, Budongo Forest (W. Uganda), Patiko (N. Uganda) and Tembura (S. Sudan).

Metisella tsadicus Auriv.[2]

" Lake Tsad."

This species was described as *ogwanyi* by Bethune-Baker and as *birbiranus* by Ungemach, who found it abundantly in the basin of the Birbir, at Youbdo and Soubé-Boro. The latter very kindly sent me a specimen which was determined as above by Evans during his revision of the HESPERIIDAE.

Prosopalpus debilis Plötz.

" Cameroons."

A rarity found by Ungemach only at Youbdo.

Acleros mackenii Trim.

" Natal to Angola and Kilimanjaro."

Found commonly in the centre as well as in Wallega. Variable underneath. Specimens in the British Museum come from " Mt. Abu Kassim 1908 " (Drake-Brockman); " Charada Forest, 6000 ft., Kaffa 1905 " (Zaphiro).

Spialia dromus Plötz.[3]

" Natal to Kilimanjaro and Gabun."

Hodson. Male, 1. Loc. 22.

Spialia diomus Hpff.[3]

" Portuguese and German East Africa."

Widely spread in the west centre and Wallega. Specimens in the British Museum come from " S.W. and S.E. Abyssinia " (Drake-Brockman); " Chaga Kulla, 5200 ft., 1905 " (Zaphiro).

Spialia spio L.[3]

" Cape Colony to Delagoa Bay, Kilimanjaro."

Hodson. Males, 2. Females, 2. Locs. 34, 39 (7.iii), 44.

Ungemach found it abundant and widespread.

British Museum specimens from " Charada Kaffa, 5000 ft., Kawara Couta, 5200 ft., 1905 " (Zaphiro); " Dirre-Daoua 1908 " (Drake-Brockman).

Spialia zebra Btlr.[3]

" Natal."

Ungemach remarked that this South African species is very rare in Abyssinia: he took one male at Bouré.

---

[1] Placed by Aurivillius in the genus *Heteropterus* Dum.

[2] Placed by Aurivillius in the genus *Cyclopides* Hübn.

[3] Placed by Aurivillius in the genus *Hesperia* Fab.

Evans writes *re* this record : " True *zebra* Butler is Oriental ; *bifida* Higgins is the scarcely different Ethiopian form which is in the British Museum collections from Kenya and south Sudan."

Spialia mangana Rbl.[1]

" Arabia."

The female holotype was taken in Arabia more than thirty years ago, but the species is little known. Ungemach took two males at Dire-Dawa differing from the female as follows. No basal spot on the upperside of the fore-wing in area 1*b*. On the hind-wing a short white median band above, below the hind-wing has a median white band separating a brownish-grey basal area from a darker marginal area.[2]

Drake-Brockman took a male at " Dirre-Daoua 1908."

Another species *S. doris* Walker (*S. adenensis*) from across the Red Sea has been taken on the Somaliland coast (Djibouti, Massowah) and by Collenette at " Buran 3000 ft." These are in the British Museum.

The next species to be dealt with was called *Hesperia sandaster* (Trimen) by Aurivillius in Seitz's *Grossschmett. Erde.* This species is, however, not referable to the genus *Hesperia* Fab., and Brigadier W. H. Evans informs me that it is at present without a valid generic name. He has accordingly been kind enough to prepare the following diagnosis of a new genus for the reception of this species :—

Alenia gen. n. Evans.

> Antennae as in *Spialia* Swinhoe, but the club is flattened to a thin oval disc with the tip bent over. Palpi as in *Spialia* Swinhoe. Fore tibiae without epiphysis : hind tibiae thinly fringed and furnished with a single pair of spurs. ♂ costa of fore-wing highly arched at base and concave in the middle : costa of hind-wing humped at the base. Termen of fore-wing indented slightly below vein 2 : termen of hind-wing slightly convex between the ends of veins 4 to 6 and indented below vein 2. Venation as in *Spialia* Swinhoe, but the end of the fore-wing cell is not inclined : on the hind-wing, vein 1A is very short and this vein is slightly decurved at its origin. Uncus divided laterally. *Spialia* Swinhoe is the nearest ally of *Alenia* Evans, but in structure and facies the two genera are very different.
>
> GENOTYPE : *Alenia sandaster* (Trimen, 1868) (= *Pyrgus sandaster* Trimen, 1868). [W. H. EVANS.]

Alenia sandaster Trim.[1]

" Cape Colony."

Recorded by Aurivillius (1922) from " Ethiopie-Moullou " and " Lac Rodolphe." The known distribution of this species is entirely South African, and the fact that Aurivillius did not repeat the record in his contribution to " Seitz " published in 1925 suggests a mistaken diagnosis.

Gomalia elma Trim.[3]

" Cape Colony to Angola, Nyasa, and Usambara."

A female in the British Museum was taken by Drake-Brockman at " Dirre-Daoua, 1908." Ungemach took one at Oumbi and one at Dire-Dawa.

---

[1] Placed by Aurivillius in the genus *Hesperia* Fab.

[2] The identification of the males as probably females of *mangana* was made by Mr. N. D. Riley at the British Museum (N.H.), to whom they were submitted.

[3] Placed by Aurivillius in the genus *Carcharodus* Hübn.

Caprona pillaana Wallengr.

" Natal to Damaraland and Rhodesia."

Hodson. Female, 1. Loc. 20 (20.ix).

Tagiades flesus F.

" Sierra Leone to Natal and Usambara."

Hodson. Males, 5. Female, 1. Locs. 2, 4, 10, 11, 65 (10.xii).

Ungemach found it widespread in the centre and west : common at Youbdo.

Eagris denuba obliterata Carptr.

South-east Sudan.

The form *obliterata* is considered by Evans to be more correctly ascribed to *denuba* than to *lucetia* to which I at first ascribed it.

Hodson. Males, 2. Females, 3. Locs. 19, 52, 55, 63, 65 (10.xii).

Ungemach gave his specimens the specific name only : it was scattered from Oumbi to the Goudder : very common at Youbdo.

Eagris nottoana Wallengr.

" Cape Colony to Delagoa Bay."

The British Museum has a specimen from " Abyssinia " (Drake-Brockman).

Eretis djaelaelae Wallengr.[1]

" South Africa to Angola, Somaliland, and Abyssinia, also in Senegambia."

Hodson. Male, 1. Female, 1. Locs. 26 (15.ix), 65 (10.xii).

Scott. Male, 1. Females, 2. Locs. D. (18–20.x), K., Zq. (28.xi).

Ungemach found it very common in the centre.

Eretis lugens Rog.[1]

" German and British East Africa to Ruwenzori."

Hodson. Males, 5. Females, 7. Locs. 17 (26.x), 38, 56 (7, 19.ii), 65 (12, 18, 24.xii).

Scott. Males, 7. Females, 2. Loc. Dj. (x.26).

Ungemach found it a western species, not passing the " Guibbé." Very abundant at Youbdo.

Sarangesa motozi Wallengr.

" Cape Colony to Angola, Somaliland, Senegambia, Abyssinia."

Hodson. Male, 1. Female, 1. Locs. 19 (20.x), 36.

Ungemach took one at Youbdo.

Sarangesa lucidella Mab.

" German East Africa."

Hodson. Female, 1. Loc. 23 (3.x).

Sarangesa laelius Mab.

Togoland to Gabun, Rhodesia, East Africa.

A synonym of this species is *synestalmenus* Karsch, while *tristis* Rebel appears to be a seasonal form.

Hodson. Males, 2. Female, 1. Locs. 4, 16, 17.

---

[1] Placed by Aurivillius in the genus *Sarangesa* Moore.

Sarangesa phidyle Walker.

Hodson. Males, 2. Loc. 23 (5, 8.x).

Ungemach recorded it as "exclusivement oriental": common at Dire-Dawa. This species was attributed by Aurivillius to *eliminata* Holland.

Celaenorrhinus galenus F.

"Senegambia to Manicaland."

Hodson. Males, 5. Females, 2. Locs. 12, 14, 19, 26 (16.iv), 65 (10, 25.xii).

Scott. Male, 1. Loc. Dj. (7–9.x).

Ungemach found it widespread in Wallega, sometimes common.

Celaenorrhinus bettoni Btlr.

"Masailand."

Ungemach noted it, under the name *Sarangesa hypoxanthina* Mab. & Boult., as found only at Youbdo.

SECTION IV. ZOOGEOGRAPHICAL AFFINITIES OF THE SPECIES KNOWN FROM ABYSSINIA.

Consideration of the Rhopalocera of "Abyssinia" from a zoogeographic aspect presents certain difficulties, since the area enclosed by a political boundary embraces territory of extremely different faunistic types; from the hot, arid, low-lying "Somali" type of country to the high mountains of the centre. The mere record "Abyssinia" is of little exact value, as Ungemach (*loc. cit.*) has pointed out in his admirable descriptive account of the types of country and the differences in the fauna. Compilation of a complete list is rendered difficult because, so often, altitude is not mentioned. As was said earlier, I decided that the 1500 metre level seemed to exclude the purely "Somaliland" type of country to the east and south, while admitting forms quite characteristic of "Abyssinia." But a difficulty was presented by the deep valleys of the Baro and Didessa rivers, cutting into the heart of the high country in the south-west and providing many of Ungemach's records. Parts, at least, of these valleys lie below the 1500 m. contour, but as no altitudes were given for specimens from these valleys they have been included. It is up these river valleys that such typical inhabitants of the lowlands as *Colotis* penetrate into the mountain country.

The fauna of the area thus defined comprises many species widely spread over Africa, but when subdivision is possible it shows the character to be predominantly *East* African; this is well shown by the PIERIDAE. But detailed analysis shows also a *Western* element, and a slight *Palaearctic* intrusion. The following list gives species and forms found in Abyssinia of which the distribution is of particular interest. I have endeavoured to include the whole distribution by consulting the "Lepidopterorum Catalogus" so far as it has been published, and examining the data on specimens in the British Museum and at Oxford.

While this paper was passing through the press, I received certain additional information, which I was fortunately able to embody in the text. This additional information has made it necessary to delete items 1 and 2 from the following list.

3. *P. echerioides oscari.* Abyssinia, and the great crater plateau in Tanganyika Territory. The species occurs from Cape Colony to East Africa and Uganda.
4. *P. cynorta arnoldi.* Abyssinia. The species occurs from Sierra Leone to Angola, Uganda, and south Sudan.
5. *P. pylades pylades.* Senegal to White Nile, Abyssinia, northern Congo. The eastern form, *pylades angolanus*, occurs in Uganda.
6. *P. latreillianus.* Sierra Leone, Southern Nigeria, Uganda, Gondokoro (south Sudan), Mumias (Kavirondo), Abyssinia (Eritrea).
7. *P. carchedonius birbiri.* The species occurs from Togo and the Congo to Uganda, South Sudan (on the border of French Equatorial Africa), and Western Abyssinia.
8. *P. antheus nyasae.* The eastern form: Natal to Kenya Colony, Uganda, and Imatong Mts. in south Sudan. Cameroons, Angola, Kasai (Congo), Abyssinia.
9. *P. a. n.* f. *evombaroides.* More western: Gold Coast, Cameroons, Ogowe, Kwangostroom (Angola), Mabira (Uganda), Abyssinia.
10. *P. sisenna.* The species occurs in Portuguese East Africa and Tanganyika Territory, and has not been recorded between that area and Eritrea whence it was reported once.
11. *P. colonna.* Delagoa Bay to Kenya Colony. Not recorded from Uganda, nor south Sudan, but from Abyssinia.
12. *Appias sabina sabina.* The western form: Sierra Leone to Angola, Abyssinia.
13. *Belenois subeida zoraida.* Cameroons, Volta, Sudan, Abyssinia.
14. *Dixeia pigea nitida* (= *D. rubrobasalis nitida*). Cameroons, Abyssinia.
15. *Pontia daplidice aethiops.* Abyssinia. The species is palaearctic.
16. *P. brassicoides brassicoides* and *P. b. b.* form *hodsoni.* The species was believed to be confined to Abyssinia until another form was discovered in the great crater of Tanganyika Territory. It has palaearctic affinities.
17. *Euchloë belemia abyssinica.* Abyssinia and Somaliland. The species is of Mediterranean distribution.
18. *Colias marnoana.* Abyssinia. The species is palaearctic.
19. *Amauris niavius aethiops.* Abyssinia. Derived from the West African race, *A. n. niavius.*
20. *A. ochleides darius.* Abyssinia. The species occurs also between Lakes Nyasa and Tanganyika and in the Comoro Islands; some of the Abyssinian specimens approach the last.
21. *A. hecate stictica.* Abyssinia. The species is typical of the West African forest region and reaches Uganda and south Sudan.
22. *A. lobengula abessinica.* Abyssinia (Eritrea), and south Sudan (Didinga). The species occurs in Rhodesia, Katanga, and Nyasaland: also at Marsabit, south east of Lake Rudolph, Kenya Colony. Abyssinian specimens are akin to Katanga forms: the Marsabit form is peculiar.
23. *Gnophodes parmeno parmeno.* West African forest region from Sierra Leone to Angola, Uganda, south Sudan, Abyssinia.

23A. *G. p. diversa.* Natal to British East Africa; Abyssinia.

24. *Mycalesis sandace.* Senegal, Cameroons, Congo, Uganda, Nairobi, Abyssinia.
25. *M. mollitia.* Congo, Ruwenzori, Uganda, Abyssinia.

26. *M. campa.* Togo, Uganda, South Sudan, Elgon, Mumias (Kavirondo), Nairobi, Abyssinia.
27. *M. vulgaris.* Sierra Leone to Angola, Lualaba, Kigoma, Uganda, South Sudan, Abyssinia.
28. *M. angulosa.* Sierra Leone, Cameroons, Angola, Kigoma, White Nile, Abyssinia.
29. *M. funebris.* Sierra Leone, Angola, Katanga, Kigoma, Congo, Uganda, Mumias (Kavirondo), Abyssinia.
30. *Pararge maderakal.* Abyssinia. The genus is palaearctic. A closely allied species has been described from Arabia (*P. felix* Warnecke, 1933).
31. *Euxanthe eurinome birbirica.* Abyssinia. The species occurs from Sierra Leone and the Niger to Angola and Uganda.
32. *Charaxes jasius epijasius.* From Senegambia to northern Uganda, Sudan, and Abyssinia. The Ethiopian race of a Mediterranean species.
33. *C. boueti rectans.* The Abyssinian race of a species occurring from Senegambia and the interior of Sierra Leone to Mombasa and Manicaland.
34. *C. lactetinctus ungemachi.* The Abyssinian race of a species occurring in the Togo interior, Adamaua (Cameroons), Northern Uganda.
35. *C. castor castor.* Abyssinian examples of *castor* belong to this western race extending from Senegambia to the Congo, south Sudan, Uganda, and Mumias (Kavirondo).
36. *C. numenes neumanni.* Abyssinia. The species occurs from Sierra Leone to Angola, Uganda, and Yala river (north-east coast of Lake Victoria).
37. *C. tiridates marginatus.* As the last, but not recorded from the north-east coast of the lake.
38. *Euphaedra inaequabilis.* Uganda, Abyssinia, Mumias (Kavirondo).
39. *E. medon.* Sierra Leone to Uganda, South Sudan, Abyssinia. Lake Tanganyika, M'pala, Lualaba River.
40. *E. sarita abyssinica.* Abyssinia. The species *sarita* (in B.M. = *inanoides* Holland) is found from Cameroons and Congo to Angola and Uganda.
41. *E. preussi neumanni.* Abyssinia. The species occurs from the Cameroons to Uganda.
42. *Pseudacraea eurytus terra.* West African forest region to Uganda, South Sudan, Abyssinia, and Tiriki hills east of Lake Victoria.
43. *P. e.* form *tirikensis.* As last.
44. *P. e.* form *epaeoides.* Abyssinia, south Sudan. Closely allied to *terra.*
45. *P. e.* form *lachesis.* Abyssinia. Close to *tirikensis.*
46. *P. e.* form *mimo-ras.* Abyssinia. Allied to *hobleyi* which occurs from the West Coast forest region to Uganda and south Sudan.
47. *P. e.* form *youbdonis.* Abyssinia. Allied to *striata* which occurs from Sierra Leone to Angola and the Congo, but not Uganda.
48. *Cyrestis camillus.* Angola, Sierra Leone, Congo, Uganda, Kavirondo, Nandi, Mt. Mlanje, Abyssinia.
49. *Kallima ansorgei.* Cameroons, M'pala (L. Tanganyika), Uganda, Mt. Elgon.
50. *Salamis cacta.* Sierra Leone to Congo, Uganda, Kibwezi (Kenya Colony), Moshi and Amani (Kilimanjaro area), Abyssinia.
51. *Catacroptera cloanthe cloanthe.* The eastern race, occurs from the Cape and Angola to Abyssinia.
52. *C. c. ligata.* The western race : Sierra Leone, Gold Coast, Togo, Cameroons, M'pala, south-western Abyssinia.

53. *Precis chorimene chorimene.* Senegal to Congo and Abyssinia.
54. *P. c.* form *angulata.* Uganda (Masindi), south Sudan, Abyssinia.
55. *P. terea terea.* The western race; Sierra Leone to Angola; Uganda, Meru (Kenya Colony), Abyssinia.
56. *P. t. fumata.* Angola, Mt. Kenya, Nandi Plateau, Somaliland, Abyssinia.
57. *P. coelestina.* Cameroons to Angola, Uganda, western Kenya Colony (Lumbwa, Nzoia R., Mumias, Elgon), Somaliland, Abyssinia.
58. *P. limnoria limnoria.* Arabia, Somaliland, Abyssinia.
59. *P. milonia.* Cameroons, Congo, Budongo Forest (Uganda), Abyssinia.
60. *P. pelarga.* Senegal to Angola, Lualaba River (Katanga), South Sudan, Abyssinia.
61. *P. octavia.* Abyssinian specimens are nearest the western race, *octavia* and its form *amestris* occurring from Sierra Leone and the Congo through South Sudan to Abyssinia and Somaliland.
62. *Argynnis hyperbius neumanni.* Abyssinia. The species occurs in palaearctic India.
63. *Melitaea abyssinica.* Abyssinia and southern Arabia.
64. *Bematistes alcinoë nado.* Abyssinia. Its very close ally, *alcinoë camerunica* occurs from West Africa to Uganda.
65. *B. poggei ras.* Abyssinia. Closely related to *poggei* which occurs from the Congo to Uganda, the east side of Lake Victoria, and Southern Sudan.
66. *B. epaea homochroa.* Abyssinia. Nearest to the West African *e. epaea* and quite different from the Uganda race.
67. *Acraea alciope.* The females are of the western brown forms, or quite peculiar forms, and not like the Uganda *aurivillii.*
68. *A. lycoa aequalis.* The Abyssinian race of a species widespread through West Africa and Uganda. It occurs also on the highlands in Kenya Colony, and on Kilimanjaro.
69. *A. peneleos gelonica.* Abyssinia. The species occurs from Cameroons to Angola, Uganda, Mumias (Kavirondo).
70. *A. encedon encedon.* The East African race extending into Uganda, Southern Sudan, and Abyssinia.
71. *A. encedon necoda.* Peculiar to the central and eastern parts of the southern Abyssinian highlands; possibly derived from the western race *e. lycia.*
72. *A. natalica abadima.* An eastern form; Congo (Stanleyville), East Africa, Uganda, Abyssinia.
73. *A. n. abadima* form *umbrata.* An eastern form; Mozambique to Kenya Colony; Lualaba, Abyssinia.
74. *A. n. abadima* form *pseudegina.* The western race; Portuguese Guinea, Sierra Leone, Gold Coast, Nigeria, Angola, Abyssinia.
75. *A. egina egina.* The north and western race; Senegal to Angola and Nyasaland, Lake Tanganyika, Congo, N.E. Rhodesia, Uganda, Kavirondo, Nandi, southern Sudan, Abyssinia.
76. *A. e.* form *areca.* Ungemach records specimens near this south-eastern form which occurs in Nyasaland, East Africa, and south-east Rhodesia.
77. *A. zetes sidamona.* Abyssinia. Close to *A. z. jalema*, a western form found in S. Thomé, Nigeria, Gaboon, Uganda, south Sudan, Nandi (Kenya Colony), Rhodesia.
78. *A. z. oscari.* Peculiar to Abyssinia but slight western affinities.
79. *A. iturina kakana.* Abyssinia. Nearest to *iturina* of Cameroons, Congo and Uganda.

80. *Spindasis banyoana.* Type from Cameroons: occurs in Uganda, Kavirondo, Abyssinia.
81. *Spalgis lemolea.* West Africa from Senegambia to Rhodesia, Uganda, Kavirondo and Abyssinia.
82. *Anthene musagetes.* Sierra Leone to Angola, Volta River, Uganda to Hoey's Bridge (Kenya), Abyssinia.
83. *A. crawshayi.* Sierra Leone, Nigeria, Katanga, Nyasaland, north-east Rhodesia, Urundi (Tanganyika), Uganda to Hoey's Bridge, Abyssinia.
84. *A. phoenicis.* Sierra Leone to Uganda and Hoey's Bridge; Rhodesia, Abyssinia.
85. *Euchrysops albistriatus.* Sierra Leone, Congo, Lake Kivu, Uganda, Mumias, Abyssinia.
86. *E. eleusis eleusis.* Senegal, Upper Volta, Nubia, Cairo, Khartum, Abyssinia.
87. *Oboronia punctatus.* Liberia, Gold Coast, Nigeria, Cameroons, Congo (Kiwu-Lowa distr.), Angola, Uganda, south Sudan, Abyssinia.
88. *O. gussfeldti.* Sierra Leone to Angola, Uganda. Mombasa, Usambara (Amani), Abyssinia, Katanga.
89. *Athysanota elorea.* Sierra Leone, Liberia, Gold Coast, Southern Nigeria, Katanga, Uganda, Abyssinia.
90. *Lycaena phlaeas pseudophlaeas.* The Abyssinian and south Arabian representative of a palaearctic species occurring in two other forms on the highlands of Kenya and Uganda. A second subspecies occurs in South Africa and Kikuyu (Kenya).
91. *Coeliades chalybe immaculata.* The Abyssinian race of a western species extending from Gambia to Angola, Congo, and Uganda. The record of *bixae* from Kilimanjaro (1888, *Proc. zool. Soc. Lond.*, **1888** : 91) probably refers to this.
92. *C. hanno.* Sao Thomé, Senegal to Angola, Congo, Lake Tanganyika, Uganda, Abyssinia.
93. *Pardaleodes incerta.* Senegambia to Angola, Congo, Lake Tanganyika, Uganda, southern Sudan, Abyssinia.
94. *Pelopidas ferruginea.* Besides Abyssinia the only localities are Dar-es-Salaam; Kipini and other places on the Kenya coast.
95. *P. noctula.* The male and female types in the British Museum come from Uganda (Tero forest, south-east Buddu) and Bitje, Cameroons. No other records available except Ungemach's single specimen.
96. *Isoteinon punctulatus.* Cameroons, Congo, Lake Tanganyika, Uganda, Abyssinia.
97. *Metisella tsadicus.* Cameroons, Lake Chad, Uganda (Budongo Forest, and Acholi country), south-west Sudan (Tembura), Abyssinia.
98. *Prosopalpus debilis.* Sierra Leone, Nigeria, Cameroons, Lake Tanganyika, south Sudan, Uganda, Kenya, Abyssinia.
99. *Spialia mangana.* Arabia and Abyssinia.

These 98 forms may be arranged as follows according to distribution. Each is referred to numerically to save space.

A. *From West Africa across to Kenya and, in some cases, to south-eastern Congo and Rhodesia.*

24, 26, 27, 29, 39, 48, 50, 60, 68, 83, 84, 88, 89, 98. Total 14.

B. *From West Africa eastwards to Uganda, south Sudan, and in a few cases into Western Kenya.*

4, 7, 9, 12, 19, 21, 23, 25, 28, 31, 35, 36, 37, 40, 41, 42, 43, 44, 45, 46, 52, 53, 55, 57, 59, 61, 64, 65, 69, 74, 75, 77, 81, 82, 85, 87, 91, 92, 93, 96. Total 40.

C. *Distribution suggesting a link between West Africa and Abyssinia by a more northern route through the Upper Volta, Lake Tchad, south Sudan and north Uganda region.*

5, 6, 13, 32, 33, 34, 86, 97. Total 8.

D. *Distribution discontinuous in West Africa and Abyssinia.*

14, 47, 49, 66, 67, 79, 80, 95. Total 8.

E. *Apparently confined to Uganda, south Sudan, and Abyssinia.*

38, 54. Total 2.

F. *Eastern forms occurring in Abyssinia with western forms of same species.*

8, 23A, 51, 56, 70, 72, 73, 76. Total 8.

G. *Distribution discontinuous in East Africa and Abyssinia.*

10, 11, 20, 22, 94. Total 5.

H. *Palaearctic links.*

15, 17, 18, 30, 62, 63, 90. Total 7.

I. *Links between Abyssinia and the Great Crater country in Tanganyika Territory.*

3, 16. Total 2.

J. *Links between Abyssinia and Arabia.*

58, 63, 99. Total 3.

K. *Peculiar to Abyssinia but probably of western origin.*

71, 78. Total 2.

Groups A–E, with K, show that there are no less than seventy-four forms or species indicating affinity with West rather than East Africa : some of those in group D suggest a former closer connection between Abyssinia and the west, since interrupted. *Antanartia hippomene* might be added to this group.

Group H (in which No. 16 might be included, to make 8) in seven cases gives a clear indication of palaearctic intrusion. The case of *Lycaena phlaeas* L. differs, for as well as in Abyssinia it occurs in Arabia, and in different forms on the mountains of Kenya, Kilimanjaro, and to the north of Lake Kivu, while the genus is represented by another species in South Africa, which occurs from Cape Colony to Natal and the Transvaal, and also in the Kikuyu country of Kenya colony ; moreover the genus occurs in the Nearctic Region. The present distribution of *Lycaena* in Africa is thus a relic of an ancient very wide distribution, and is not to be considered as evidence of palaearctic intrusion.

No. 62 is the important Asiatic intruder, and it is interesting that it has not been able to pass over the lowlands and escape from Abyssinia. No. 30 is the only Ethiopian representative of a typically northern genus.

Group J might have been expected to be larger : it could have been increased if the lowland, Somali, type of country had been included. The climate of the higher elevation doubtless is unsuited to Arabian fauna. *Precis orithyia here* Lang, occurring in Mesopotamia, Palestine and south-eastern Arabia may be included, but it is probably only a dry-season form similar to such forms occurring in India. The type is from Damascus.

Group I is of peculiar interest. Two forms, believed to be entirely Abyssinian, have been discovered in the great crater country in the northern part of Tanganyika Territory. One is a slightly modified palaearctic species, *Pieris brassicoides* Guér., of which the Abyssinian examples differ only in quite minor details from the Tanganyika specimens: in the other case, *Papilio echerioides* Trim., the same form *oscari* occurs in both areas. The specimens are above suspicion, and the case is rendered more interesting by the fact that Mr. B. D. Burtt of the Tsetse Research Department, Tanganyika Territory, kindly allows me to mention that he has found a species of *Acacia* in the great crater area that had previously only been recorded from Abyssinia. The form *oscari* of the *Papilio* is less remarkable than the *Pieris*; for *echerioides* occurs in the intervening country, whereas no specimen of *brassicoides* was known outside Abyssinia before the record cited by Joicey and Talbot (1922) in Tanganyika Territory. It is obvious that further developments of knowledge are much wanted here.

The characteristics of the fauna of an area are ascertained both by studying what is there, and by noting what is absent, and the latter reveals some remarkable features.

PAPILIONIDAE. The absence of *P. policenes* Cr., one of the commonest African Papilios from Sierra Leone to Angola, from Natal to Kenya, Uganda and the Uganda–Sudan border on the Acholi hills; of *P. bromius* Dbl. which abounds in West and East Africa up to Uganda and the Imatong mountains of Southern Sudan; and of the common mountain species *P. mackinnoni* E. Sh. found on Ruwenzori, Elgon, and Kenya is very surprising.

Among the PIERIDAE *Colotis elgonensis* E. Sh. occurs on Elgon and Ruwenzori and in the mountains of southern Sudan, yet has not been recorded from Abyssinia: it also occurs on the west side of Lake Victoria where I took it on low-lying plains at about 4000 ft., and in the north-west Cameroons. The specimens from the Sudan approach those from the Cameroons. *Pontia helica johnstoni*, which occurs commonly on the highlands of Kenya Colony and Uganda, has not been recorded from Abyssinia.

Among the DANAIDAE a notable absentee is *Amauris damocles* Beauv. which in varying form abounds from the west coast to the east and from Nyasaland to the mountains of southern Sudan.

SATYRIDAE on the whole are poorly represented, but this may be due to the comparative unattractiveness of this group. None of the large western *Mycalesis* (*iccius*, etc.) have been found in Abyssinia, but on the other hand the species that do occur are on the whole of West African type.

Henotesia, a genus more characteristic of the east than the west, has only a single species in Abyssinia, while *Neocenyra*, entirely East African, has not been recorded from Abyssinia although several species exist in Somaliland and *N. gregorii* Btlr. abounds in the Didinga Mts. of south-eastern Sudan.

NYMPHALIDAE provide many interesting points. The following absentee *Charaxes* are remarkable: *C. pelias* Cr. in one form or another distributed from Cape Colony and Natal to the Congo and British East Africa; *C. pollux* Cr., which in two forms occurs from Sierra Leone to Uganda, and from Manicaland, and Nyasaland to Kilimanjaro; *C. ethalion* Bdv., which is found from the Cape to Kenya Colony.

The large forest Nymphalines, so characteristic of the West African region as far as Uganda and even the Imatong mountains of south-eastern Sudan, are barely represented in Abyssinia. *Cymothoë* seems totally absent, even the abundant, migratory, *caenis* Drury which occurs in the Imatong mountains, has not been recorded. The genera *Eurypheura*, *Diestogyna* and *Euryphene* (except for a glimpse of one recorded by Ungemach) are absent, and *Euphaedra* is poorly represented by four species, not including the common *spatiosa* Mab. which occurs from West Africa to Uganda and the Imatong mountains. On the other hand, the six named forms or species of *Euphaedra* occurring in Abyssinia are in four cases only known from that area, pointing to a period of isolation. *Catuna* is absent, also *Pseudoneptis* which occurs on the Imatong mountains. *Ergolis* occurs from Sierra Leone to Uganda, the mountains of the Uganda–Sudan frontier and Tanganyika Territory, but has not been recorded from Abyssinia.

Precis, well represented by both West and East African forms, provides a very remarkable absentee, *archesia* Cr., the various forms of which are distributed throughout South and East Africa from Angola to the Didinga and Imatong mountains of south Sudan, and in West Africa.

Vanessula milca Hew. occurs commonly from the Cameroons to the Congo, Uganda, and south Sudan, but not in Abyssinia. Very surprising is the absence of the small species of *Argynnis* from Abyssinia, for two species abound on the highlands of Kenya Colony and Uganda.

A few of the Acraeids are worthy of notice. *Bematistes quadricolor* Rog. in various forms occurs on Ruwenzori and the highlands between it and Lake Kivu in western Uganda; on Elgon, Kenya, Kilimanjaro and the surrounding highlands, yet not in south Sudan or Abyssinia: it thus recalls the smaller *Argynnis*. *Acraea johnstoni* Godm., frequenting the same areas in various forms, and south Sudan, is absent from Abyssinia. A number of species of *Acraea* which extend from West Africa across to Uganda, Kenya, and in some cases to South Sudan, are absent from Abyssinia; e.g. *A. oreas* E. Sh., *A. pentapolis* Ward, *A. viviana* Stgr., *A. cepheus* L., and so are some typically eastern species such as *conjuncta* Sm., which abounds on the Didinga mountains.

The LYCAENIDAE provide a very striking peculiarity. The Liptenine subsection, so strongly represented from West Africa up to Uganda and even the Imatong mountains, is entirely absent from Abyssinia except for a single *Pentila*, a widely distributed open-country type. Among LYCAENINAE the genus *Cyclirius*, of which Aurivillius says " The species seem to prefer mountainous districts and some are evidently alpine dwellers," occurs from Cape Colony to all the chief East African mountains and the mountains of the Uganda–Sudan frontier: its distribution is like that of the smaller *Argynnis* (in East Africa) and *Bematistes quadricolor*, and like them it is absent from Abyssinia.

HESPERIIDAE are so much less collected, and their distribution therefore so little worked out, that the group cannot be utilised for these remarks: the presence of the characteristically western *Coeliades chalybe* Dbl., but in a peculiar form, is of much interest.

These notable absentees are indicated in the table on page 419.

SECTION V. ALTITUDES TO WHICH CERTAIN SPECIES ARE CONFINED IN ABYSSINIA.

It will now be of interest to consider the question of *altitude*, and examine those Abyssinian forms that, being on the whole well defined, may be taken as characteristic of the country concerned. The collection made by Hodson, in

WIDELY DISTRIBUTED.	WESTERN FORESTS.	EASTERN.	EASTERN MOUNTAINS.
Papilio policenes. *Papilio bromius.* *Amauris damocles.* *Charaxes pelias.* *Ergolis* sp. *Precis archesia.*	*Mycalesis* (the large spp.).* *Charaxes pollux.* *Cymothoë* sp.* *Euryphura* sp. *Diestogyna* sp.* *Euryphene* sp. *Euphaedra* (common species, such as *spatiosa*).* *Catuna* sp. *Pseudoneptis* sp.* *Mesoxantha* sp.* *Vanessula milca.** *Acraea oreas.* *Acraea pentapolis.* *Acraea viviana.* *Acraea cepheus.** The subfamily LIPTENINAE.*	*Henotesia* sp. *Neocenyra* sp. *Acraea johnstoni.*	*Papilio mackinnoni.* *Pontia helice johnstoni.* *Colotis elgonensis.* *Argynnis* (the small spp.). *Bematistes quadricolor.* *Acraea conjuncta.* *Cyclirius* sp.

* There are specimens of these in the Hope Department from northern Uganda and/or the Imatong mountains.

most cases with altitudinal data, is of particular interest since it embraced both highlands and the low-lying country on the Sudan–Abyssinian border.

The following species or forms about which it may be claimed that there is a reasonable amount of information, are given as examples.

Papilio dardanus antinorii. Specimens with the rich orange underside characteristic of *antinorii* have been taken at such different altitudes as Pulo Vlei and Apeni river at 1400 and 1700 ft., and Gore (6600), Gammachisa (6800) and Anderacha (7900), by Hodson. On the other hand, specimens with pale underside like that of nominotypical *dardanus* were taken in the Apeni river at 1700 ft. and Leman river (2300) as well as at Gammachisa at 6800 ft. There appears to be no limitation of *antinorii* to higher altitudes, or of forms linking it with *dardanus* to lower altitudes.

P. echerioides oscari. Taken by Hodson at altitudes from 3700 to 6000 ft., but on the whole a form of the higher levels : Ungemach's specimens are not assigned to the lower parts visited by him : Neumann's and Scott's specimens are from high levels. This species is of eastern affinity.

P. cynorta arnoldi. A species of western affinity : occurs as low as 1400 ft. but up to 7900 ft.

P. aethiops. Eastern affinity, near to *P. bromius.* Hodson did not take it below 5500 ft., and it occurs at high levels.

Mylothris mortoni. No records of occurrence at low elevation.

M. erlangeri. Probably of eastern affinity : confined to high levels.

Danaus formosa neumanni. Eastern affinity : high levels.

Amauris niavius aethiops. Western affinity. Taken by Hodson at 1700 and 2200 ft., as well as at 6900 ft. Neumann also took it on the Uma river, Konta.

A. ochleides darius. Eastern affinity. Taken by Hodson at 2100 ft. and up to 6000 ft.

A. hecate stictica. Western affinity. Hodson's specimens all come from 4500 ft. or higher; Ungemach took it on the Baro river which he places at about 2000 ft.

A. echeria steckeri, Eastern affinity. Hodson's specimens were not taken below 5500 ft.: Ungemach found it chiefly in Wallega forests, but the elevation is not given.

Mycalesis safitza aethiops occurs at elevations as low as 2500 ft., but also as high as 6500 ft.

Charaxes boueti rectans was taken by Hodson at very low levels, about 2300 ft., and by Ungemach on the Didessa river, presumably at low level.

C. lactetinctus ungemachi was taken by Ungemach at Youbdo (5200 ft.): Hodson's specimen of the new form *brunneus* at 6900 ft.

Euphaedra preussi neumanni, of western affinity, comes down as low as 1400 ft., and does not appear to have been recorded from altitudes much over 5000 ft.

Pseudacraea eurytus. The several forms of this species do not appear to be characteristic of high levels: Hodson took *tirikensis* at 5500 ft., and Ungemach recorded forms from Oumbi at about 6000 ft., but specimens have been taken at 3200 ft., including the peculiar *youbdonis*.

P. lucretia walensensis first recorded from Mt. Walengo at high level, has been taken by Hodson at 2200 ft.

Bematistes epaea homochroa seems not to occur at levels lower than about 5200 ft.

B. alcinoē nado, of western affinity, occurs at 1700 ft. (Hodson).

B. poggei ras occurs at 5200 ft. and "on the Guebba" which probably implies not a very high altitude.

Acraea lycoa aequalis, one of the characteristic Abyssinian forms, has not been taken at levels lower than 6000 ft.: Hodson took it at 7700 ft.

A. safie, not known outside Abyssinia; particularly frequents the higher levels, though Hodson took a few at 4500 ft. Ungemach records that it was not found "on the Baro." On the other hand, it is commonly found up to 8000–9000 ft.

A. encedon necoda. Hodson did not encounter this, and Ungemach records that it was very common at Addis Ababa: it appears to be confined to the more eastern part of the southern highlands. Scott took it at 8000–9500 ft. on Mt. Chillalo: Drake-Brockman on Malka Jilo on the edge of the highlands east of Addis Ababa.

A. maji, a modified *terpsichore*, was only taken by Hodson at 7700 ft.

A. zetes oscari, another characteristically Abyssinian form, has not been taken below about 6000 ft, and frequents higher altitudes.

A. iturina kakana, of western affinity, is little known, but seems to occur at low levels for Hodson's specimen comes from about 4500 ft.

The smaller species belonging to LYCAENIDAE and HESPERIIDAE are so much less known that it is probably better to leave them out of consideration from this aspect: it is perhaps worth noting that the Hesperid *Coeliades chalybe immaculata*, very characteristically West African in affinity, came from the low level of 2700 ft.

It appears therefore that the following species or forms can be taken as *well defined entities confined to the high levels above* 5000 *ft.* They are arranged in columns according to their probable geographical affinities.

Palaearctic.	East African.	West African.	Unknown or doubtful.
Pontia daplidice aethiops. *Pieris brassicoides.** *Euchloë belemia abyssinica.* *Colias marnoana.* *Pararge maderakal.* *Argynnis hyperbius neumanni.* *Lycaena phlaeas pseudophlaeas.**	*Papilio aethiops.* *Mylothris erlangeri.* *Danaus formosa neumanni.* *Amauris echeria steckeri.* *Acraea maji.*	*Bematistes epaea homochroa.* *Acraea lycoa aequalis.* *A. encedon necoda.* *A. zetes oscari.*	*Mylothris mortoni.* *Acraea safie.*

* With the exceptions noted previously.

Charaxes lactetinctus has an interrupted distribution; in the interior of Togoland and Cameroons and in northern Uganda.

It will be useful to summarise the main points in connection with the eastern or western affinities of Abyssinian Rhopalocera.

Conclusion 1. The fauna on the whole is of East African type.

Conclusion 2. A large number (given as 74) forms or species with *West* African affinities occur in the area under consideration (above 1500 metres), but they are mostly neither confined to the highlands nor are they the only members of the highland fauna.

Conclusion 3. Some of the modified forms peculiar to Abyssinia are undoubtedly of *East* African affinity.

Conclusion 4. Certain forms, whether of western or eastern affinities, considered as local modifications are found mixing with the ordinary present-day forms of their nearest relations. Thus on Mt. Chillalo the normal *Acraea encedon* of East Africa has been caught on the same day as the modified form *necoda*, and the modified form *oscari* of *Acraea zetes* has been taken with the form *sidamona* transitional to the common *jalema* of Uganda and Kenya colony.

Conclusion 5. Eastern and western representatives of the same species may be found together, at localities below the 1500 metre level, *e.g.*, Nos. 8 and 9; 48 and 49; 67, 68, and 69; 70 and 71; a phenomenon which occurs with other species in Uganda.

Conclusion 6. Some of the most characteristic elements of the typical *West* African forests are missing or extremely poorly represented in Abyssinia. But examples occur on the chain of mountains along or near the Sudan–Uganda border; for instance, *Mylothris chloris* F., *Mycalesis asochis congolensis* J. & T., *Charaxes zelica* Ky., *Euphaedra eleus* Drury, *Mesoxantha ethosea* Drury, *Apaturopsis cleocharis* Hew., *Salamis temora* Fldr., *Vanessula milca* Hew., *Telipna bimaculata albofasciata* Auriv., *Mimacraea*, and *Aphnaeus asterius* Plötz.

Conclusion 7. On the other hand, among the *West* African elements in Abyssinia many are inhabitants of bush rather than thick forest country, judging by what is known of the habits of the actual species or, if peculiar, their near allies. Not quite half of those listed under headings A and B previously may be considered as "bush" forms: and there is the group C to be added to these.

Conclusion 8. A number of species, and two whole groups, inhabiting the highlands and mountains of Kenya and Uganda are absent from Abyssinia. Moreover, two Satyrine genera strongly represented in East Africa are absent (*Neocenyra*) or very poorly represented (*Henotesia*) in Abyssinia.

Conclusion 9. There are a few very definite palaearctic links of which one is with the mountains of western India: two have also been found in an isolated crater in Tanganyika Territory.

Conclusion 10. Three forms are Arabian in affinity.

SECTION VI. BRIEF NOTES ON OTHER ABYSSINIAN INVERTEBRATES.

It will now be of interest to compare these conclusions with the results of work upon other invertebrates of Abyssinia. The Omer-Cooper–Scott expedition of 1926–7 investigated some groups for the first time, and greatly extended knowledge of others: the results have by no means been fully published as yet, but the papers which have appeared in many cases give useful summaries of previous work on Abyssinian fauna, and from them I have taken the following notes.

It is not intended here to discuss fully the origin of the whole Abyssinian invertebrate fauna: I do not desire to anticipate the work of another, moreover there is much to be gained by awaiting further data. But the western character of a portion of the Rhopalocerous fauna stands out so clearly that it is worth examining records of other groups presenting sufficient data to see how they compare. This apparent irregularity was noted and commented upon by Longstaff (1916 : 274, 276, 279), who wrote: "Professor Poulton says that there are many resemblances between the fauna of Abyssinia and that of the West Coast." Generally speaking, it is the *Eastern* character that attracted attention, *e.g.*, Butler 1876—although his collection was probably from the Sudan; Reiche 1847, who writes: "Nous aurons plus d'une fois à constater ce fait curieux, de l'existence, tout le long de la côte orientale de l'Afrique, du cap de Bonne Espérance jusq' à l'Abyssinie, des mêmes genres et des mêmes espèces. La côte occidentale ne présente pas ce caractère."

I. Rotifera.

Bryce (1931) found 47 species and varieties in the Omer-Cooper material, the majority being cosmopolitan: there is no literature dealing with West African species.

II. Vermes.

(a.) Nematoda.

Filipjev (1931) described five out of ten Abyssinian species as new; the rest are widely spread.

(b.) Oligochaeta.

Stephenson (1932) discussed the 1926–7 specimens as well as Michaelsen's account of Neumann and Erlanger's collections. The Microdili are of little use in establishing zoogeographical relationships. The earthworms (Megadili) obtained in 1926–7 were all new species and belong to *Dichogaster* (already known to constitute a large ingredient of the Oligochaete fauna of the region), *Platydrilus*, and *Malodrilus*, which have previously been found in Abyssinia. This collection therefore only emphasises the previously established purely tropical African character of the Oligochaete fauna. *Abyssinia is probably extremely rich in new and endemic species.*

III. Mollusca.

Connolly (1931) divided Africa, so far as mollusca are concerned, into the following zoological provinces. North-west Africa, Sudan, Abyssinia, Central Africa (from Atlantic to Indian ocean and from Sudan to the Zambesi), South Africa. The main points affecting the present paper are that as regards molluscs *the western types extend eastwards to the Indian ocean*, the Rift Valley forming no barrier, and the extreme insularity of Abyssinia with a *very high proportion of endemic species.* There is strong palaearctic affinity (*Vitrina*). The Abyssinian province divides the Sudan province into an eastern section (Somaliland) with strong Arabian element, and a western section (Sudan and Egypt) which links the north-western province with the Central. An account of the 1926–7 collection is given by Connolly in 1928.

IV. Crustacea.

(a.) Fresh-water fauna in general.

Omer-Cooper (1930) in a preliminary general account found no indication that remnants of an ancient fauna of the higher Crustacea are preserved in Abyssinia. It is suggested that *Pleistocene dessication* may have been a reason, or possibly great falls of volcanic dust. The fauna of the lakes gave no indication of early palaearctic immigration as it seems to be of quite recent origin from the countries to the south.

(b.) Copepoda.

Lowndes (1930) found that all of the 16 species recorded from Abyssinia are of practically world-wide distribution.

(c.) Ostracoda.

The same authority (1932) wrote that knowledge of this group is insufficient to allow of any conclusions regarding Abyssinia.

V. Hydracarina.

Walter (1930) reported that the 1926–7 expedition collected the first known Hydracarina from Abyssinia. Five of the seven species were new : the fauna of the surrounding country is too little known to allow comparison.

VI. Insecta.

(a.) Collembola.

Handschin (1929). The closest affinities of the fifteen Abyssinian Collembola are with the fauna of the adjoining mountains : *none are of West African type.*

(b.) Orthoptera.

Blattidae. It appears from Adelung (1903) that the Blattid fauna of Abyssinia has its chief affinity with East Africa, and that *West Africa plays little* *part.* There is palaearctic affinity with Asiatic species. No ANAPLECTINAE are known: a group with many species in the Orient, New World, and a few in West Africa. The EPILAMPRINAE, well represented in West Africa, are exemplified in Abyssinia by a species from South and East Africa: it is well represented also in Madagascar and the tropics of Asia, Australia, and the New World, and to a smaller extent in South Africa and on Kilimanjaro. The genera most fully represented in Abyssinia are among BLATTINAE, *Pseudoderopeltis* almost restricted to North, South, and East Africa, and *Deropeltis* also known from the west. The PERISPHAERINAE are represented by a genus not known in the west. The POLYPHAGINAE are of great interest. Seven species of *Heterogamedes* (Chopard 1929) are intermediate between a genus inhabiting the Asiatic mountains and other genera of desert habitat from Turkestan to Morocco and Senegal. Chopard considered that the African POLYPHAGINAE originated in Central Asia and that the highlands of Abyssinia with their dryness and windiness reproduce the desert environment necessary to this group.[1]

MANTIDAE are shown by Werner (1908) to be characteristically East African: a large number of species is common to East and South Africa and there *is not one occurring also in West Africa.* The leaf-like species of East Africa which may be regarded as true inhabitants of the primeval forest occur unchanged in Madagascar but have not found their way into the West African forest region. (*N.B.* See later remarks on the West African forests.) The only palaearctic elements are widely distributed and are common in North Africa or South Europe, representing tropical genera of great powers of adaptation.

Uvarov (1934A) dealt with the Orthoptera of the 1926–7 expedition, except for BLATTIDAE. The mountain fauna shows unmistakable affinity with the East African fauna and there is no trace of the most northern elements of the palaearctic fauna of the "Angara group" (Uvarov 1921 and 1934B: 36–8), derived from Eastern Siberia and Northern China. (*N.B.* Compare BLATTIDAE above.) Apparent evidence of affinities with other palaearctic elements is dismissed by Uvarov who, referring to a species common in the palaearctic deserts, pointed out that it has penetrated into Abyssinia up the river valleys to 5500 ft., above which level the influence of semi-desert climate is not felt. Uvarov thus disagreed with Chopard's explanation of the presence of Polyphagine Blattids. He found that the endemic species of the highlands probably represent *very recent offshoots of their relatives in the surrounding lowland savannahs.*

(c.) Aquatic Hemiptera.

The following brief notes are from the papers by Hutchinson (1930, 1932, 1933). The lowland fauna consists chiefly of widespread species and perhaps a few endemic species though the latter probably occur also in the adjacent parts of Central Africa. The highland fauna is characterised by endemic species found chiefly at over 8000 ft. These may be relatively recent immigrants or newly evolved species which have established themselves in the highlands since a glacial desiccation. *There is little affinity with West Africa*: out of the 27 species collected by Omer-Cooper 7 also occur in West Africa, and, of these, 5 are also found in Uganda and/or Southern Rhodesia or even the Union, and one also in the Nile Valley. The only species recorded, from Abyssinia and the West is doubtfully identified for Abyssinia. The CORIXIDAE show "clear palaearctic affinities."

---

[1] I am especially indebted to Dr. R. Hanitsch, M.A., for much help with this paragraph on BLATTIDAE.

(d.) Neuroptera.

Esben Petersen (1928) records twenty-one species of Neuroptera from Abyssinia, of which the affinities are entirely East African. Only one widely spread species also occurs in West Africa.

(e.) Lepidoptera. (Microlepidoptera.)

The account given by Meyrick (1932) of the Omer-Cooper–Scott collection, the first recorded from Abyssinia, is of unusual interest. Fifty species provided forty-two which were endemic : these were mainly mountain representatives of species from lower elevations. The genus *Plutella*, of world-wide distribution. provided new forms most nearly allied to those of Central Europe, which show that an immigration during a glacial period must have taken place.

(f.) Coleoptera.

Reicher (1847) alluded to species common to Senegal and Abyssinia, and to the distribution of genera and species from Abyssinia through East Africa to the Cape, and that this was not the case along the West Coast.

Raffray (1882, 1885) showed that the species of the lower valleys and plains of the interior (below 2000 m.) were of Senegal type while on the higher mountains there was strong affinity with European mountains.

Jeannel (1912), when considering the mountains of East Africa pointed out that certain alpine species cannot live in the wet dense vegetation of Kenya and Ruwenzori but occur on Kilimanjaro and in Abyssinia. The two former arise from high plateaux with heavy rainfall; the latter from dry lowlands.

(i.) DYTISCIDAE.

Omer-Cooper (1931) gives a total of 79 species collected by the 1926–7 expedition : the main bulk consists of species widely distributed in East and South Africa. But 5 *are only found elsewhere in the Western forest region*, and two from Senegal are found also, in one case in South-west Africa, in the other in North Africa and Somaliland. Palaearctic affinity is weak; the few species also occurring in Europe are widely spread.

(ii.) HALIPLIDAE.

Pearce (1931) reported that one of the two species found by the 1926–7 expedition was previously only known from the Congo (*H. nigrosignatus* Rég.).

(iii.) CARABIDAE.

Alluaud (1932) discussed *Calathus* and other palaearctic CARABIDAE which inhabit Abyssinia. *Calathus*, unlike other palaearctic genera of bettles, does not go further south than 8° N., and frequents altitudes of 2000–3000 metres.

(iv.) STAPHYLINIDAE.

Scott (1931) gives the distribution of 64 of the 67 known Abyssinian species. There is a quite small northern, and *a very weak West African* element : the East African affinity strongly predominates. The weak West African element consists of 6 forms referred either doubtfully, or as varieties, to species occurring in the Congo or in West Africa.

(g.) Hymenoptera.

(i.) FORMICIDAE.

The ants of the 1926–7 expedition are discussed by Scott (1933). Nineteen species were obtained, representing 13 genera: four of them were new to science. The affinities are with East Africa, except in the case of widely distributed forms: an interesting case is the discovery of a species of *Rhoptromyrmex* of which no member had previously been known in Abyssinia. Wheeler (1922) gave the distribution of the genus as the *West African forest belt* and in a strip from the Victoria Falls to the Cape Province, touching the East coast from Port Elizabeth southwards. It is worth noting that Wheeler's distributional maps show that the genus *Oecophylla,* occurring through the tropical forests of Africa (except for Madagascar), India, Malay, New Guinea and northern Australia, has not been found in the Abyssinian forests.

(ii.) VESPIDAE.

Bequaert and Scott (1933) discuss the VESPIDAE of Abyssinia. The 31 species, except for two confined to Abyssinia, are almost entirely of East African distribution when not ranging over tropical Africa in general. There are no special West African affinities. One of the endemic species is of a palaearctic type which appears to have invaded the eastern Ethiopian highlands.

(iii.) Fossoria.

Arnold (1933) gave an account of the SPHEGIDAE and PSAMMOCHARIDAE of the 1926–7 expedition to which Scott added a list of all known Abyssinian species. Eleven forms are apparently unknown outside Abyssinia: the rest are more or less widely distributed in the Ethiopian region, especially in East and South Africa. There are no special links with West Africa.

(iv.) Apoidea.

The Apoidea, exclusive of *Andrena* and *Halictus* are considered in a paper by Alfken (1932) annotated by Scott, who refers to Friese (1915). The species from the highlands are mostly widely spread in tropical Africa, especially East, and sometimes South as well. Twenty species enumerated include only four peculiar to Abyssinia. There are affinities with the East African mountains: the only *Melipona* was originally described from Elgon; two forms occur together at 8000–9000 ft. in Abyssinia, a third on Ruwenzori. There is *little evidence of affinity with purely West African fauna*, but mention may be made of *Nomia bouyssoni* Vachal, described from the French Congo. A specimen in the British Museum from Abyssinia bears this name, but in the present state of knowledge of this group too much stress should not be laid upon this.

(h.) Diptera.

Scott (1927) records 14 species of CULICIDAE from Abyssinia which are either widely spread through the Ethiopian region or of East African type.

SECTION VII. CONCLUSIONS.

The following facts emerge from consideration of the groups just mentioned.

(1) In no group is the West African affinity of Abyssinia shown to such a

degree as in Rhopalocera; but in the Coleoptera the DYTISCIDAE and to a smaller extent STAPHYLINIDAE, HALIPLIDAE and FORMICIDAE also show it.

(2) The groups in which the high percentage of endemic species has particularly attracted attention are characterised by comparatively slow dispersal (Mollusca, Oligochaeta).

(3) The palaearctic element is proportionately less clearly shown in the Rhopalocera than in Mollusca, BLATTIDAE, Aquatic Hemiptera, Microlepidoptera, or CARABIDAE.

The apparently greater West African affinity in Rhopalocera may perhaps be due to the greater amount of attention paid to them so that more material is available, and the greater ease with which geographical races can be discerned by the large area on which variations in colour and pattern may be spread out. The colder climate of the glacial times apparently made it possible for palaearctic elements to penetrate southwards into what is nowAbyssinia, the elevation of the country having made it possible for these species to survive. *Lycaena*, however, would appear to be on a somewhat different footing and to be more of the nature of a " Pluvial relict," to use Hutchinson's term. Not only are various forms of one species spread over the mountains of East Africa and Uganda, Abyssinia and the south Sudan, but another species of considerably different appearance has its head-quarters in South Africa and is also found in Kenya on the highlands.

A striking feature of distribution is the montane tree flora of the Abyssinian and East African mountain forests. Since the days of Hooker interest has been aroused in the similarity shown by the flora of Abyssinia and Fernando Po (see 1903, *More Letters of Charles Darwin*, **1** : 465, 477 and **2** : 5), and it is now known that there is even identity of species between the Cameroon mountains and Abyssinia. Patches of this montane forest are found in Usambara (north-east of Tanganyika Territory) and on Mt. Mlanje (Nyasaland) and at the sea-level in temperate South Africa. Charles Darwin concluded (*loc. cit.*) that this forest had spread from east to west, and I gathered from Dr. Burtt Davy that there is some affinity with the Indo-Malayan flora which suggests that the " montane " tree flora may have come from the east. It is distinct from the tropical West African forests in which the most characteristically Ethiopian Rhopalocerous fauna is found.

Now the Rhopalocera of the East African sub-region, which surrounds the Western sub-region, have considerable affinity with those of the Indian region; e.g. *Colotis*, *Belenois*, *Danaus*, *Precis*, *Byblia*, *Ergolis*, *Phalanta*. The Lycaenid genus *Nacaduba*, well represented in the Indian region, exists on Mauritius and the Seychelles as well as on the continent. These examples are frequenters of " bush " rather than thick forest, but it is interesting that some of the forest species also belong to Indian genera; e.g., *Kallima*, *Cyrestis* (the only African member of a large Indo-Malayan group with one species peculiar to Madagascar), and *Charaxes*. There is thus a definite suggestion that the characteristic East African Rhopalocera may have come in from the Orient. After the MS. of this paper was completed, an important contribution by Warnecke (1933) was brought to my notice by Dr. Hugh Scott, which purports to give a complete list of palaearctic species or forms in the Ethiopian region. It contains a record which had eluded my notice (*Melitaea abyssinica* Oberth.), but omits *Pieris brassicoides*. Warnecke discusses the Ethiopian elements in the southern

Arabian Lepidopterous fauna, and points out that until recently the palaearctic butterflies in Abyssinia and further south seemed cut off from their general habitat. Collections made in 1928 and 1931 added to the known fauna of southern Arabia the following species –*Pontia daplidice*, *Pararge felix* Warn. allied to *P. menava* Moore of the Himalayas and closely related to *P. maderakal*, *Melitaea abyssinica* and *Lycaena phlaeas* resembling *pseudophlaeas*. Warnecke therefore suggests that southern Arabia has served as the bridge for the dispersal of these and other species into non-palaearctic Africa, and that some emigrants from Africa have found their way by it into Arabia. It is also pointed out that there is considerable similarity of flora between Abyssinia and the region of Yemen in Arabia. As regards *Lycaena*, however, the other forms of *phlaeas* in the mountains of East Africa and the other species in South Africa suggest, as has been previously written, that this genus is a pluvial relict in Africa, although Warnecke's suggestion may hold good for the Abyssinian race.

The possibility of derivation of the African "steppe" fauna partly by invasion from Asia and partly by modification of forest forms through climatic changes is discussed in an interesting paper by Brästrup (1935), who refers to a paper by Lonnberg (1929).

Extremely interesting is the distribution of the polymorphic Nymphaline *Pseudacraea eurytus* L., which recalls that of the montane forest. It occurs in Abyssinia, Usambara and the neighbourhood of Mombasa, Mlanje, and Natal; but is also highly characteristic of the tropical rain forest of the West African subregion, in which it is found from the coast through Uganda to the east side of Lake Victoria and the mountains of the southern Sudan. Moreau points out in an interesting paper on birds (1933) that "the key to the whole problem lies in the expansion and contraction of closed forest of one type or another. Whether the forest is completely evergreen or to some extent semideciduous does not seem to be important so long as it is a tall closed association that does not lose a considerable proportion of its leaves at any particular season."

The presumed former extension of the "montane" forest helps to explain the present distribution of this characteristic forest species outside the tropical rain forest which must at the present time be considered the headquarters of the species on account of the wealth of forms there. But is it not possible that the great development of *P. eurytus*, as of other members of this fauna, took place within the rain forest as it gradually spread from the coast? The work of Wayland (who has been good enough to embody his views in a short memorandum forming an Appendix to this paper) suggests that the West African rain forest could have extended continuously, at any rate along river banks, up to south Sudan at least.

Chipp (1929) states that *Chlorophora excelsa* Benth. & Hooker, *Entandrophragma macrophyllum* A. Chev., and *Khaya grandifolia* C.D.C. occur on the Imatong mountains. The first of these trees is widely distributed from West Africa into East Africa; the second is known from French Guinea, Ivory Coast, Gold Coast and French Cameroons; the last from French Guinea, French Cameroons and Upper Ubangi. Dr. J. Burtt Davy kindly gave me these facts and informed me that all three trees are considered to be typical members of the West African forests, *but have not been recorded from Abyssinia.* Their absence from Abyssinia is in accord with the curious facts previously mentioned that although certain West African species seem to have reached the country (e.g., *Papilio cynorta*, *Amauris hecate*, which have become modified into a distinct race) a number of species and even the whole sub-family Lipteninae of the Lycaenidae have not got beyond south Sudan. In this connection the

Abyssinian specimens of *Mylothris agathina* are interesting. They have been mentioned as of the eastern, comparatively lightly marked form of this variable species. The heavily marked western form which links *M. agathina* with *chloris* occurs in Uganda and southern Sudan but not in Abyssinia.

If it is a question of the temperature being too low in Abyssinia it is curious that such essentially tropical species as the *Papilio* and *Amauris* just mentioned should be able to accommodate themselves : moreover, in south-west Abyssinia at the comparatively low levels at which Hodson took these species, the conditions cannot be very different from those on the Imatong mountains in the south Sudan ; indeed the climate of the latter is probably colder.

An interesting paper by Schwarz (1929) on the distribution of the entirely arboreal black and white *Colobus* monkeys is to some extent in harmony with the views here discussed. He considers that the Congo basin was formerly submerged and the monkeys originated on the south side. As this area gradually became dry the *Colobus* spread westwards, northwards, and eastwards, some reaching Abyssinia.

The formation of a dry, hot, low-lying belt in the region of 5° N. seems to have effectually prevented the extension of most of the West African trees and butterflies, and also of many East African species. Although some of the peculiar forms or species in Abyssinia are obviously of East African origin they have no connection nowadays with their allies : the break in continuity must have come after they had entered the country, and prevented such species as *Papilio policenes* Cr., *P. mackinnoni* E. Sharpe, etc., from reaching Abyssinia.[1] This makes the meeting of *Acraea encedon* with its altered form *necoda* and of *A. zetes sidamona* with *A. z. oscari* the more interesting.

The absence of the small African " species " of *Argynnis* is particularly puzzling. They occur on the mountains of Kenya and Uganda (*A. hanningtoni* Elwes) and to the north of Lake Tanganyika (*A. baumanni* Rebel & Rogenh.); the latter being closely allied to the former. Another (*A. excelsior* Btlr.) occurs in Northern Nigeria, the Cameroons, and Ruwenzori. Riley (1932) described a form *imatonga* of *A. hanningtoni* from the Imatong mountains which presents a mixture of the characters of *excelsior* and *hanningtoni* hitherto regarded as distinct species : they have not been recorded as flying together. This form suggests that these small *Argynnis*, of northern affinity, are derived from a stock which entered the Ethiopian area through the southern Sudan and diverged in different directions with the formation of distinct species. But if this is so it is most extraordinary that no record exists of a specimen in Abyssinia ! This is an enigma which may be solved in the future, as also the absence from Abyssinia of that very common and widespread species, *Precis archesia* Cr., which abounds in south Sudan.

One more point remains to be discussed : it centres round *Precis octavia* Cr., which in Abyssinia is of an appearance suggesting *western* origin. The specimens from south Sudan (Carpenter, 1928) are also somewhat similar although those of Uganda are of the eastern and southern race. This is pre-eminently a " bush " species and not an inhabitant of forests. In the analysis of the 98 forms whose distribution is of special interest, groups C and D were mentioned as suggesting that there might have been a former closer connection to Senegal via the Lake Tchad region, north of the forest belt. Talbot (1929A) has shown also that there is an affinity between the Rhopalocera of the Upper Volta and of south Sudan. Raffray's conclusion (1885) that in

---

[1] *P. policenes* reaches the Acholi hills along the Uganda–Sudan border but is replaced by *P. antheus nyasae* on the Imatong mountains.

Abyssinia at 1000–2000 metres the Coleoptera of the valleys and lower plateaux show close affinity with those of Senegal, and Reiche's remarks (1847) are of interest in this connection. The Rhopalocera of the Nuba mountains (Longstaff, 1916) show that this area forms a link, for *Precis octavia* is there more like the Abyssinian form than the eastern form. *Colotis evippe* L. is of interest here also. At present it occurs in the west from Senegal to Angola, and in the east in Abyssinia, south Sudan, Uganda, Kenya, and Tanganyika Territory. This distribution strongly suggests a break in continuity, and that the species passed westwards across territory now unsuited to it but formerly more thickly bushed, and with greater rainfall.[1]

The following summary of the discussion may be given.

1. The distribution of certain Rhopalocera supports the view that the montane forest of Abyssinia formerly extended to the Cameroons, Usambara, Mt. Mlanje and South Africa.
2. The forests of the West African sub-region spread over the Congo basin and extended up to the mountains of south Sudan, carrying with them a characteristic Rhopalocerous fauna.
3. Development of a hot dry belt in the region of 5° north prevented this western flora and fauna from entering Abyssinia, although a few species of butterflies, and the *Colobus* monkeys, were not so prevented. Many characteristic East African butterflies have also not entered Abyssinia, and palaearctic invaders have not penetrated further south.
4. There was formerly thicker bush, and presumably greater rainfall, between Abyssinia and Senegal, whereby a continuity of distribution (not necessarily complete at one time) was established for a number of species of Rhopalocera.
5. Detailed analyses of the peculiarities of Abyssinian Rhopalocera will be found on pp. 411–418, and the question of altitude is discussed on pp. 418–422.

SECTION VIII. LIST OF PAPERS REFERRED TO.

ADELUNG, N., 1903, Blattodées rapportées . . . de l'Abyssinie méridionale et des contrées limitrophes en 1898. *Annu. Mus. zool. St. Petersb.*, **8**: 300–37.

ALFKEN, J. D., 1932, Entomological expedition to Abyssinia 1926–7. Hymenoptera I. Apoidea (exclusive of *Andrena* and *Halictus*). Annotated by Hugh Scott. *Trans. ent. Soc. Lond.*, **80**: 47–55.

ALLUAUD, C., 1932, Etude des *Calathus* d'Abyssinie. *Afra.*, **5**: 5–8.

ARNOLD, G., 1933, Entomological expedition to Abyssinia, 1926–7. Hymenoptera, II. Sphegidae and Psammocharidae. *Ann. Mag. nat. Hist.*, (10) **11**: 351–371.

AURIVILLIUS, CHR., 1898, Rhopalocera Aethiopica.

—— 1922, Voyage de M. le Baron de Rothschild en Ethiopie et en Afrique Orientale Anglaise (1904–5). Paris, 1922.

—— 1925, *in* Seitz "The Macrolepidoptera of the World," **13**. African Rhopalocera.

---

[1] In this connection allusion may be made to a paper by Sandford (1935) in which he concludes that in Kordofan and Dongola dead trees are not evidence of encroachment of desert but that they have been drowned by too much surface water. Thus the bush at the present day may well be less dense than in the past.

BERNHAUER, M., 1931, Entomological expedition to Abyssinia, 1926–7: Coleoptera, Staphylinidae. [Contains an introduction and discussion on distribution by Hugh Scott.] *J. linn. Soc. Zool.*, **37**: 559–605.

BOULLET, E., and LE CERF, F., 1912, Descriptions sommaires de formes nouvelles de PAPILIONIDAE (Lep.). *Bull. Soc. ent. Fr.*, **1912**: 141.

BRÄSTRUP, F. W., 1935, Remarks on Climatic Change and Faunal Evolution in Africa. *Zoogeographica*, **2**: 484–494.

BRYCE, D., 1931, Report on the Rotifera: Mr. Omer-Cooper's investigation of the Abyssinian fresh waters (Dr. H. Scott expedition). *Proc. zool. Soc. Lond.*, **1931**: 865–78.

BUTLER, A. G., 1876, On a collection of Lepidoptera recently received from Abyssinia. *Ann. Mag. nat. Hist.*, (4) **18**: 480–90.

——, 1897A, A revision of the species of Butterflies belonging to the genus *Teracolus* Swains. *Ann. Mag. nat. Hist.*, (6) **20**: 385–507.

——, 1897B, On a collection of Lepidoptera obtained in the Arusa Galla country in 1894 by Mr. F. Gillett. *Proc. zool. Soc. Lond.*, **1897**: 692–5.

——, 1898, A list of Butterflies obtained in Harar highlands by Capt. H. G. C. Swayne, R.E. *Proc. zool. Soc. Lond.*, **1898**: 821–2.

CANNAVIELLO, H., 1902, About some Rhopalocera collected near Erythraea colony at Adi-Ugri. *Miscel. ent.*, **10**: 2–8.

CARPENTER, G. D. HALE, 1928, Two collections of butterflies from the S.E. corner of the Sudan. *Trans. ent. Soc. Lond.*, **76**: 25–54.

——, 1933, *Acraea doubledayi rileyi* Eltr. from the Southern Sudan. *Proc. R. ent. Soc. Lond.*, **8**: 110.

——, 1935, Interesting butterflies from the Sudan–Congo border. *Proc. R. ent. Soc. Lond.*, **9**: 89–90.

CHIPP, T. F., 1929, The Imatong mountains, Sudan. *Kew Bull.*, **29**: 177–97.

CHOPARD, L., 1929, Les polyphagiens de la fauna paléarctique. *Eos, Madrid*, **5**: 223–358.

CONNOLLY, M., 1928, On a collection of land and freshwater mollusca from Southern Abyssinia. *Proc. zool. Soc. Lond.*, **1928**: 163–84.

——, 1931, The distribution of non-marine Mollusca throughout continental Africa. *J. Conch.*, **19**: 98–107.

DIXEY, F. A., 1903, On Lepidoptera from the White Nile. *Trans. ent. Soc. Lond.*, **1903**: 141–63.

——, 1918, The *charina* group of *Pinacopteryx*. *Trans. ent. Soc. Lond.*, **1918**: 191–208.

DONALDSON SMITH, A., 1895, Expedition to Somaliland. *Geogr. J.*, **5**: 124–7.

ELTRINGHAM, H., 1913, On new or little-known forms of *Acraea*. *Trans. ent. Soc. Lond.*, **1913**: 407–13.

——, 1917, Rhopalocera from Fernando Po. *Proc. ent. Soc. Lond.*, **1916**: 93.

ESBEN-PETERSEN, P., 1928, Neuroptera and Embiidina from Abyssinia and Somaliland. *Ann. Mag. nat. Hist.*, (10) **1**: 442–50.

FILIPJEV, I., 1931, Report on the freshwater Nematoda: Mr. Omer-Cooper's investigation of the Abyssinian freshwaters (Hugh Scott expedition). *Proc. zool. Soc. Lond.*, **1931**: 429–43.

FRIESE, H., 1915, Zur Bienenfauna von Abessinien. *Deuts. ent. Z.*, **1915**: 265–98.

GUERIN-MÉNEVILLE, F. E., 1849, Insectes dans "Voyage en Abyssinie exécuté pendant les années 1839–43 par Lefebvre." Paris, **6**: 364–86.

GUIGLIA, D., 1932, Contributo alla conoscenza della fauna imenotterologica dell' Africa orientale. *Mem. Soc. ent. ital.*, **10**: 118–136.

HANDSCHIN, E., 1929, Collembola from Abyssinia. *Trans. ent. Soc. Lond.*, **77**: 15–28.

HOLDHAUS, K., 1929, Die geographische Verbreitung der Insekten die äthiopische region die Hochgebirgsfauna Abessiniens und der ost-afrikanischen Vulkane. *in* Schröder *Handb. Ent.*, Jena, **2**: 826–7.

HUTCHINSON, G. E., 1930, Report on NOTONECTIDAE, PLEIDAE, and CORIXIDAE (Hemiptera). Mr. Omer-Cooper's investigations of the Abyssinian fresh waters (Dr. Hugh Scott's expedition). *Proc. zool. Soc. Lond.*, **1930** : 437–66.

——, 1932, Supplementary report on NOTONECTIDAE, PLEIDAE, and CORIXIDAE (Hemiptera) : Mr. Omer-Cooper's investigations of the Abyssinian fresh waters (Dr. Hugh Scott's expedition). *Proc. zool. Soc. Lond.*, **1932** : 125–30.

——, 1933, The zoo-geography of the African aquatic Hemiptera [with many references]. *Int. Rev. Hydrobiol.*, **28** : 436–68.

JEANNEL, R., 1912, Sur la faune des hautes montagnes de l'Afrique orientale *Assoc. franc. avanc. Sci. Nimes*, **41** : 424–8.

JOANNIS, J. DE, and VERITY, R., 1913, Materiali per lo studio della fauna Eritrea, raccolti nel 1901–3 dal Dott A. Andreini. *Bull. Soc. ent. ital.*, **44** : 115–22.

JOICEY, J. J., and TALBOT, G., 1922, New forms of butterflies from Africa. *Bull. Hill. Mus.*, **1** : 339–42.

JORDAN, K., 1905, Der Gegensatz zwischen geographischer und nichtgeographischer variation. *Z. wiss. Zool.*, **83** : 151–210.

LE CERF, F., 1924A, Catalogue annoté des "Types" et formes nouvelles des Papilios d'Afrique contenus dans la collection du "Hill Museum." *Bull. Hill Mus.*, **1** : 369–99.

——, 1924B, Contribution à la faune des Lepidoptères de l'Erythrée. *Ann. Soc. ent. Fr.*, **93** : 193–210.

LE DOUX, C., 1928, Über eine Acraeen-Ausbeute aus Abyssinien. Acraeen-Studien III. *Deuts. ent. Z.*, **1928** : 112–3.

LEIGH, G. F., 1904, Synepigonic series of *Papilio cenea*, etc. *Trans. ent. Soc. Lond.*, **1904** : 679–685.

LONGSTAFF, G. B., 1913, The Butterflies of the White Nile : a study in geographica distribution. *Trans. ent. Soc. Lond.*, **1913** : 11–56.

——, 1916, Butterflies of Southern Kordofan, collected by Captain R. S. Wilson. *Trans. ent. Soc. Lond.*, **1916** : 269–88.

LÖNNBERG, E., 1929, The development and distribution of the African Fauna in connection with and depending upon climatic changes. *Ark. f. Zool.*, **21** A (4) : 1–33.

LOWNDES, A. G., 1930, Freshwater Copepoda from Abyssinia collected by Mr. J. Omer-Cooper. *Proc. zool. Soc. Lond.*, **1930** : 161–78.

——, 1932, Report on the Ostracoda. Mr. Omer-Cooper's investigation of the Abyssinian freshwaters (Dr. Hugh Scott's expedition). *Proc. zool. Soc. Lond.*, **1932** : 677–708.

MEYRICK, E., 1932, Entomological expedition to Abyssinia, 1926–7, Microlepidoptera. *Trans. ent. Soc. Lond.*, **80** : 107–20.

MOREAU, R. E., 1933, Pleistocene climatic changes and the distribution of life in East Africa. *J. Ecol.*, **21** : 415–43.

——, 1934, A contribution to tropical African bird-ecology. *J. Anim. Ecol.*, **3** : 41–69.

MOULTON, D., 1928, Thysanoptera from Abyssinia. *Ann. Mag. nat. Hist.*, (10) **2** : 227–48.

NEUMANN, O., 1902, From the Somali coast through Southern Ethiopia to the Sudan. *Geogr. J.*, **1902**.

OBERTHÜR, C., 1880, Spedizione italiana nell' Africa equatoriale. Risultati zoologici. Lepidotteri. *Ann. Mus. Stor. nat. Genova*, **15** : 129–87.

——, 1883, Spedizione italiana nell' Africa equatoriale. Risultati zoologici. Lepidotteri. *Ann. Mus. Stor. nat. Genova*, **18** : 709–40. [See also *Mem. Soc. geogr. Ital.*, **2** (3) : 21–52.]

——, 1909, Études de Lépidoptérologie comparée, **3** : 243–4. [See also 1915, *loc. cit.*, **10** : Pl. 282, figs. 2303–2304.]

OMER-COOPER, J., 1930, Dr. Hugh Scott's expedition to Abyssinia—A preliminary investigation of the freshwater fauna of Abyssinia. *Proc. zool. Soc. Lond.*, **1930** : 195–207.

Omer-Cooper, J., 1931, Report on the Dytiscidae (Coleoptera), Mr. Omer-Cooper's investigation of the Abyssinian fresh waters (Hugh Scott expedition). *Proc. zool. Soc. Lond.*, **1931** : 751–801.

Pagenstecher, A., 1902, Wissenschaftliche resultate der reise . . . durch Süd-Schoa, die Galla und Somaliländer in 1900 und 1901, Tagfalter. *Jahrb. nassau. Ver. Naturk.*, **55** : 113–204.

Pearce, E. J., 1931, Report on the Haliplidae (Coleoptera) : Mr. Omer-Cooper's investigation of the Abyssinian fresh waters (Hugh Scott expedition). *Proc. zool. Soc. Lond.*, **1931** : 31–2.

Poulton, E. B., 1905, Appendix to " *The source of the Blue Nile* " by A. J. Hayes : 313–315. London.

——, 1924, *Papilio dardanus.* The most interesting butterfly in the world. *J. E. Afr. Ug. nat. Hist. Soc.*, **20** : 4–22.

——, 1926a, Interesting new races of Papilios from S.W. Abyssinia and Somaliland. *Proc. ent. Soc. Lond.*, **1925** : xlii–lii.

——, 1926b, The tailed mimetic female of *Papilio dardanus hodsoni* Poult., taken in S.W. Abyssinia by Mr. Arnold Hodson. *Proc. ent. Soc. Lond.*, **1** : 6–7.

——, 1927a, A new tailed female form of *Papilio dardanus hodsoni* Poult., taken by Mr. Arnold Hodson in W. Abyssinia. *Proc. ent. Soc. Lond.*, **2** : 10–11.

——, 1927b, Some Papilios taken at Djem-Djem in Central Abyssinia by Dr. Hugh Scott. *Proc. ent. Soc. Lond.*, **2** : 35–6.

——, 1928a, A *niavoides*, Kheil, female of *Papilio dardanus hodsoni* Poult., with exceptionally long " tails " taken in S.W. Abyssinia by Arnold Hodson, C.M.G. *Proc. ent. Soc. Lond.*, **2** : 49–50.

——, 1928b, Intraspecific Selection, an attempt to explain the origin and meaning of certain examples of mimicry. *Proc. zool. Soc. Lond.*, **1928** : 1042–3.

Raffray, A., 1882, *Bull. Soc. ent. Fr.*, (6) **2** : 5–6.

——, 1885, Note sur la dispersion géographique des Coléoptères en Abyssinie et descriptions d'espèces nouvelles. *Ann. Soc. ent. Fr.*, (6) **5** : 293–326.

Reiche, L., 1847, *in* Voyage en Abyssinie par Ferret et Galinier, Paris 1847, **3** : 259.

Reichensperger, A., 1913, Zur Kenntniss von Myrmecophilen aus Abessinien. *Zool. Jahrb. Jena* (*Syst.*), **35** : 185–218.

Riley, N. D., 1921, Notes on the *Rhopalocera* of the Dollman Collection. *Trans. Ent. Soc. Lond.*, **1921** : 234–59.

——, 1928, Two new local races of *Euchloë.* *Entomologist,* **61** : 136.

——, 1932, New African and Arabian butterflies. *Ann. Mag. nat. Hist.*, (10) **10** : 137–52.

Rothschild, W., and Jordan, K., 1903, Lepidoptera collected by Oscar Neumann in North-east Africa. *Novit. Zool.*, **10** : 491–542.

—— ——, 1905, Lepidoptera collected by Oscar Neumann in North-east Africa. *Novit. Zool.*, **12** : 175–191.

Sandford, K. S., 1935, Sources of water in the north-western Sudan. *Geogr. J.*, **85** : 421, 431.

Saussure, H. de, and Zehntner, L., 1895, Revision de la Tribu des Périsphaeriens. *Rev. suisse Zool.*, **3** : 1–60.

Schmidt, C. W., 1921, Neue oder wenig bekannte afrikanische Rhopaloceren. *Deuts. ent. Z. " Iris,"* **35** : 32–3.

Schwarz, E., 1929, On the local races and distribution of the black and white *Colobus* monkeys. *Proc. zool. Soc. Lond.*, **1929** : 585–98.

Scott, H., 1927, Notes on the distribution and habits of Culicidae in Central Abyssinia. *Bull. ent. Res.*, **18** : 83–9.

Scott, H., and others, 1933, Entomological expedition to Abyssinia, 1926–7. Hymenoptera, III. *Ann. Mag. nat. Hist.*, (10) **12** : 97–120.

——, 1935, Coleoptera associated with the giant Lobelias and arborescent Senecios of eastern Africa. *J. linn. Soc. Zool.*, **39** : 235–84.

SHARPE, E. M., 1896, List of Lepidoptera obtained by Dr. A. Donaldson Smith during his recent expedition to Lake Rudolf. *Proc. zool. Soc. Lond.*, **1896:** 530.

STEPHENSON, J., 1932, Report on the Oligochaeta. Mr. Omer-Cooper's investigation of the Abyssinian fresh waters (Dr. Hugh Scott's expedition). *Proc. zool. Soc. Lond.*, **1932** : 227–56.

STRAND, E., 1911A, Neue Grossschmetterlinge aus Abyssinien gesammelt von Herrn A. Kostlan. *Ent. Rdsch.*, **28** : 137–40.

——, 1911B, Tagfalter und Schwärmer aus Abyssinien gesammelt von Herrn A. Kostlan. *Arch. Naturgesch.*, **77** Suppl. (4) : 87–97.

TALBOT, G., 1929A, Rhopalocera collected in the region of the Haute Volta, French West Africa. *Bull. Hill. Mus.*, **3** : 225–33.

——, 1929B, Butterflies from South-east Sudan. *Bull. Hill. Mus.*, **3** : 96–8.

——, 1932, New forms of African Lepidoptera. *Bull. Hill. Mus.*, **4** : 170–7.

——, 1935, New species and forms of African LYCAENIDAE (Lep. Rhop.). *Ent. Mon. Mag.*, **71** : 69–78, 115–127, 147–153.

ULMER, G., 1930, Entomological expedition to Abyssinia 1926–7 ; Trichoptera and Ephemeroptera. *Ann. Mag. nat. Hist.*, (10) **6** : 479–511.

UNGEMACH, H., 1932, Contribution à l'étude des Lepidoptères d'Abyssinie. 1re Partie. Rhopalocères. *Mem. Soc. Sci. nat. Maroc.*, **32** : 1–122.

UVAROV, B. P., 1921, The geographical distribution of Orthopterous insects in the Caucasus and in Western Asia. *Proc. zool. Soc. Lond.*, **1921** : 447–72.

——, 1934A, Entomological expedition to Abyssinia 1926–7 : Orthoptera of the families MANTIDAE, GRYLLIDAE, TETTIGONIIDAE, and ACRIDIDAE. *J. linn. Soc. Zool.*, **28** : 591–614.

——, 1934B, Studies in the Orthoptera of Turkey, Iraq, and Syria. *Eos, Madrid*, **10** : 21–119 (with special reference to 36–38).

WALTER, C., 1930, Report on the *Hydracarina*. Mr. Omer-Cooper's investigation of the Abyssinian fresh waters (Dr. Hugh Scott's expedition). *Proc. zool. Soc. Lond.*, **1930** : 913–927.

WARNECKE, G., 1933, Ueber die zoogeographische Bedeutung der Tagfalterfauna Südarabiens. *Zoogeographica*, **1** : 573–578.

WERNER, F., 1908, Die Mantodeen Abessyniens. St. Peterburg, *Annu. Mus. Zool. St. Petersb.*, **13** : 108–128.

WHEELER, W. M., 1922, Ants of the American Museum Congo Expedition. *Bull. Amer. Mus. nat. Hist.*, **45** : 39–329.

LIST OF NEW NAMES PROPOSED IN THE PRESENT PAPER.

(*a*) Names proposed by Carpenter.

	PAGE
Papilio aethiops R. & J. form *oribazoides* forma n.	331
Pieris brassicoides brassicoides Guèr. form *hodsoni* forma n.	343
Charaxes lactetinctus ungemachi Le Cerf, form *brunneus* forma n.	359
Acraea servona God. f. *digitata* forma n.	378
Acraea terpsichore L., ab. *bankoides* ab. n.	384
Acraea maji sp. n.	385
Coeliades chalybe immaculata ssp. n.	404

(*b*) Names proposed by Evans.

Zenonia gen. n.	405
Alenia gen. n.	409

(*c*) Name proposed by Hemming.

Bematistes gen. n.	374

APPENDIX 1.

Note on the genotypes of three genera of Rhopalocera represented in the fauna of Abyssinia.

By FRANCIS HEMMING, C.B.E.

When at Professor Hale Carpenter's request, I undertook to revise the nomenclature employed in his catalogue of the butterflies of Abyssinia, I found that in the case of three invalid generic names in common use, it was impossible to substitute correct names without some explanation. In the case of *Planema* Doubleday, the true type is a species belonging to an entirely different genus; in the case of *Lycaenesthes* Moore and *Rhopalocampta* Wallengren, there are older generic names, which should be used in their place as soon as their types have been designated.

NYMPHALIDAE.

Bematistes Hemming.

No type was designated by Doubleday when he published the name *Planema* Doubleday (1848, *Gen. diurn. Lep.* (1) : 140). The first author to designate a type was Scudder (1875, *Proc. Amer. Acad. Arts Sci., Boston* **10 :** 252), who designated the first of the species placed in this genus by Doubleday, viz. *Acraea lycoa* Godart, 1819. This species is congeneric with *Papilio horta* Linnaeus, 1764, the type of *Acraea* Fabricius, 1807. The position is, therefore, that *Planema* Doubleday is a synonym of *Acraea* Fabricius.

We are thus faced with the necessity of finding a generic name for the group of species usually placed in the genus *Planema* Doubleday, *e.g.* by Aurivillius (1913, *in* Seitz, *Grossschmett. Erde* **13 :** 239–246). As there was no valid name available, I have proposed the name *Bematistes* Hemming for this genus (see p. 374). This name was suggested to me by Prof. Hale Carpenter.

LYCAENIDAE.

The following genus, proposed by Doubleday, has at present no validly designated type. I, therefore, now designate its type as follows :—

Anthene Doubleday.

Doubleday, 1847, *List. Spec. lep. Ins. B.M.* **2** : 27
Scudder, 1875, *Proc. Amer. Acad. Arts Sci., Boston* **10** : 113

TYPE : *Papilio larydas* Cramer, 1780.

Doubleday definitely assigned to this genus only two published species, viz. *Papilio larydas* Cramer, 1780, and *Thecla galathea* Swainson, 1821. He did not designate a type for this genus. When Scudder dealt with this question in his "Historical Sketch," he also did not designate a type for this genus, since he regarded the name *Anthene* Doubleday as a homonym of *Anthenea* Gray (1840, *Ann. Mag. nat. Hist.* **6** : 279). This view is, of course, incorrect under the existing International Code. No subsequent author has designated a type for this genus. Whichever of the two species placed in this genus by Doubleday is designated as the type, it is inevitable that a well-known generic name should be displaced. *Papilio larydas* Cram. is congeneric with *Lycaenesthes bengalensis* Moore, 1865, the type of *Lycaenesthes* Moore, 1865, and *Thecla galathea* Swainson is congeneric with *Dipsas epijarbas* Moore, 1857, the type of *Deudorix* Hewitson, 1863. Of these names, I consider that it is more important to preserve *Deudorix* Hewitson. I have, therefore, here designated *Papilio larydas* Cram. as the type of *Anthene* Doubleday, of which genus *Lycaenesthes* Moore thus becomes a synonym. I have accordingly substituted the name *Anthene* Doubleday for *Lycaenesthes* Moore as the generic name for the species usually assigned to the latter genus, which are listed on pages 393–396 of Professor Hale Carpenter's catalogue.

HESPERIIDAE.

The following genus, proposed by Hübner, has at present no validly designated type. I, therefore, now designate its type as follows :—

Coeliades Hübner.

Hübner, 1818, *Zuträge z. Samml. exot. Schmett.* **1** : 31
id., [1819], *Verz. bekannt. Schmett.* (7) : 106
Scudder, 1875, *Proc. Amer. Acad. Arts Sci., Boston* **10** : 145

TYPE : *Papilio forestan* Stoll, 1782.

Scudder treated this name as having been first published in Hübner's *Verzeichniss*, and from the three species there given by Hübner he selected *Papilio dubius* Stoll, 1781, as the type. That selection is, however, invalid, for Hübner did not include *Papilio dubius* Stoll in the genus *Coeliades* Hübner, when he first published that name in the first volume of the *Zuträge.* In the latter work, published a year earlier than the seventh signature of the *Verzeichniss*, Hübner included in the genus *Coeliades* Hübner two species only, viz. *Coeliades taminatus* Hübner, 1818, and *Papilio forestan* Stoll, 1782. Of these two species, *Papilio forestan* Stoll was subsequently included by Hübner in the genus *Coeliades* Hübner in the *Verzeichniss*, while *Coeliades taminatus* Hübner was not. I have, therefore, here designated *Papilio forestan* Stoll as the type of *Coeliades* Hübner, it being the only species included in that genus on each of the first two occasions on which Hübner used that name. It is, moreover, the first of the three species included in that genus in the *Verzeichniss.*

Papilio forestan Stoll, here designated as the type of *Coeliades* Hübner, is also the type of *Rhopalocampta* Wallengren (1857, *K. Vet. Acad. Handl. Stockh.* (n.f.) **2** (1) No. 4 : 47), having been so designated by Scudder (1875, *Proc. Amer. Acad. Arts Sci., Boston* **10** : 263). Thus *Rhopalocampta* Wallengren is nothing but a synonym of *Coeliades* Hübner. I have accordingly substituted *Coeliades* Hübner for *Rhopalocampta* Wallengren as the generic name for the species usually assigned to the latter genus, which are listed on page 404 of Professor Hale Carpenter's catalogue.

APPENDIX 2.

Note on some climatic and topographic changes in relation to biological distribution.

By E. J. WAYLAND.

In so far as they may be supposed to have affected the distribution of living things, the following changes in the late geological climate of eastern central Africa, including Abyssinia, may be noted.[1]

---

[1] Readers interested in East African Pleistocene climate and tectonic changes, as such, should refer to "Rifts, Rains, Rivers and Early Man in Uganda," *J. R. Anthrop. Soc.*, **64**.

There have been two Pluvial Periods separated by an Interpluvial in what is widely regarded as Pleistocene time,[1] and two "wet" and two "dry" post-Pluvial (or epi-Pluvial) phases of lesser intensity. Leaky regards these epi-Pluvial events as far-reaching in importance,[2] but I consider them relatively insignificant, and Moreau[3] has shown good reason to doubt their efficacy to induce floral and faunistic changes. It has been found, too, that each Pluvial contains an Intrapluvial, but neither of these need be considered in the present connection.

Doubtless forest extended right across equatorial Africa and for great distances south and north of the equator, thus including Abyssinia, during the first Pluvial, which started at the end of Pliocene days; but the Interpluvial, which reached its maximum in the middle Pleistocene, was a long, very dry period and must have been responsible for extinguishing the pre-existing flora and concomitant fauna—except perhaps for remnants along the east and west coast belts.

It seems, then, that apart from certain conceivable consequences of eventual contact (by means of gallery forests during the early stages of the second Pluvial) between living relics of an earlier regime and a newly established biological complex, it was in Pluvial II, and especially at the peak of the Pluvial (perhaps some thirty thousand years ago, when vast areas of Africa were again reforested from sea to sea) that the present floras and faunas of the moister areas originated.

Although higher than at the beginning of Pluvial I, the general land-level during the first part of Pluvial II was below that of the present day; and although the rift valleys were strongly marked, they were less pronounced in depth and steepness than they are now. The Nile was well established, but in all probability it did not function very effectively as a barrier against the spread of forest, and still less against the migration of winged creatures.

Until some time after the peak of the period, the physical conditions in Pluvial II were recalled in a general way by those of Pluvial I. But in the decline of the second Pluvial came the latest of the great earth-movements that fashioned the rift valleys. It intensified and steepened the scarps by depressing the rift-valley floors and elevating their sides to the order of 1000 feet or more in some places; and with these movements was coupled wide-scale differential uplift whereby parts of the affected areas rose more than others, the Abyssinian highlands being almost certainly a case in point.

Physical barriers were thus intensified and with the oscillatory decline of the Pluvial, the rift valleys, except where lakes persisted, developed a more or less arid or xerophytic setting, and the same is true of vast stretches of low-lying country outside the rift zones. The connecting strands of gallery forest have thus been broken up to a very great extent, and with regard to plants and animals an era of discontinuous distribution has set in during the last ten thousand years or less.

---

[1] I regard the present time as part of the Pleistocene, and consider it probable that the second Pluvial Period of East Africa has not yet completely passed away.

[2] Leakey, L. S. B. *The Stone Age Cultures of Kenya Colony*, Cambridge, 1931.

[3] Moreau, R. E. 1933, Pleistocene Climatic Changes and the Distribution of Life in East Africa, *J. Ecol.*, **21**, 415–443.

EXPLANATION OF PLATE VIII.

FIG. 1. *P. dardanus antinorii* Oberth. (= *hodsoni* Poult. holotype). South-west Abyssinia, Nado's Province, Ganji river, 5500 ft., 7 February, 1925 (*A. W. Hodson*).

2. *P. dardanus antinorii.* South central Abyssinia, Djem-Djem forest, 45 miles west of Addis Ababa, about 8000 ft., 1–3 October, 1926 (*H. Scott*). In the National collection: photograph by permission.

3. *P. dardanus byatti* Poult., holotype. Somaliland, Golis mountains 45 miles south-east of Berbera, near top of Wagar mountain, 6000 ft., 1–2 July, 1906 (*H. A. Byatt*).

4. *P. dardanus*, an abnormal specimen of *polytrophus* R. & J., for comparison with *byatti.* The fore-wing shows yellow penetrating along the veins into the black as in *byatti*, but the curve of the black margin in area 7 is normal for *polytrophus.* Black markings of hind-wing little developed, but dark pattern on under surface well marked as in normal *polytrophus*, and much stronger than in *byatti.* "Nairobi district, about 5500 ft," 1904 (*C. F. Elliott*).

5. *P. d. antinorii* ab. *extensiflava* Le Cerf. South-west Abyssinia, Doa, 7° 55′ N. 35° 27′ E., 5600 ft., 22 January, 1927 (*A. W. Hodson*).

6. *P. dardanus*, specimen intermediate between *antinorii* and *cenea* Stoll; in general appearance suggesting *cenea*, but fore-wing has area 7 as in *antinorii.* Absence of pale subapical spot noteworthy. South-west Abyssinia, Gerba Dima, 7° 57′ N. 35° 28′ E., 6000 ft., 21 January, 1927 (*A. W. Hodson*).

All specimens males and in the Department of Entomology of the Oxford University Museum unless otherwise stated.

EXPLANATION OF PLATE IX.

Papilio dardanus Brown, ♂ and ♀ forms.

FIG. 7. *P. d.* f. *cenea* Stoll, ♂. Tails show western character. Sierra Leone, 1908 (*Quartermaster-Sergeant Lawrence*).

8. *P. dardanus*, ♂. Possibly a hybrid, showing primitive characters of discocellular spot, and strongly developed nervular black teeth, on fore-wing. Area 7 as in northern race, but general appearance of *cenea.* Under surface as in typical *cenea*, with none of the orange of *antinorii.* South-west Abyssinia, Leman river, 2300 ft., 2 November, 1925 (*A. W. Hodson*).

9. *P. d. antinorii*, ♀. Of form like 8: costal bar and hind-wings heavily marked. From a locality close to that of 8. South-west Abyssinia, Kide's Village, 7° 34′ N. 34° 52′ E., 2100 ft., 12 November, 1925 (*A. W. Hodson*).

10. *P. d. antinorii*, ♀. Very small costal bar. Incursion of yellow into black border of fore-wing in areas 2 and 3. South central Abyssinia, Djem-Djem forest 45 miles west of Addis Ababa, 8000–9000 ft., 7–9 October, 1926 (*Hugh Scott*). In the National collection: photograph by permission.

11. *P. d. antinorii*, ♀. Under surface to show the first beginnings of black connection between end of costal bar and border. Note pale spots in border in areas 2 and 3, only visible above as minute points. Discocellular spot well developed above. Data as for fig. 9.

12. *P. d. tibullus* Kirby, ♂. Maximal development of black markings, with large discocellular spot. Base of area 7 of fore-wing yellow. Tails of hind-wings show the separate components of the black markings. Rabai, 14 miles north-west of Mombasa, 700 ft., 9 December, 1911 (*K. St. A. Rogers*).

All specimens in the Department of Entomology of the Oxford University Museum unless otherwise stated.

EXPLANATION OF PLATE X.

FIG. 13. *Papilio dardanus polytrophus* R. & J., ♂, ab. *maculatus* Suff. Complete series of submarginal pale spots in black border of fore-wing. Tails show last vestige of black arch markings consisting of narrow line along inner side of base. From same locality as No. 4, Plate VIII. " Nairobi district, about 5500 ft.," 1904 (*C. F. Elliott*).

14. *P. dardanus antinorii*, ♀-f. *niavioides* Kheil. Described in 1927, *Proc. ent. Soc. London*, **2** : 49–50. Tails exceptionally long. Submarginal spots in areas 2 and 3 of fore-wing. South-west Abyssinia, Nado's Province, Haeto river, 6000 ft., 23 January, 1927 (*A. W. Hodson*).

15. *P. rex abyssinicus* Poult., ♂, holotype. South-west Abyssinia, Nado's Province, Ganji river, 5500 ft., 7 February, 1925 (*A. W. Hodson*).

16. *Pieris brassicoides brassicoides* Guèr. f. *hodsoni* Carpenter, ♂, holotype. South-west Abyssinia. Shoa Ghimira Province, Tamanjayage, 28 January, 1925 (*A. W. Hodson*).

17. *P. brassicoides brassicoides* Guèr. f. *hodsoni* Carpenter, ♀, allotype. South-west Abyssinia, Mocha district, Ganji river, 5500 ft., 10 February, 1925 (*A. W. Hodson*).

All specimens in the Department of Entomology of the Oxford University Museum.

EXPLANATION OF PLATE XI.

FIG. 18. *Papilio echerioides oscari* Rthsch. ♂. South-west Abyssinia, top of Gura Farda range, circa 6° 50′ N. 35° 7′ E., 6000 ft., 18 February, 1927 (*A. W. Hodson*).

19. *P. cynorta arnoldi* Poult., ♂. Compare large spot in area 6 of fore-wing, with its absence in the next specimen (No. 20), and larger marginal spots on hind-wing, producing resemblance to No. 18. South-west Abyssinia, Koricha or Koricho, 7° 6′ N. 35° 27′ E., 3700 ft., 10 February, 1927 (*A. W. Hodson*).

20. *P. cynorta cynorta* F., ♂. Form most abundant in areas from which *P. echerioides* is absent, showing the characteristic of the species. Sierra Leone, 1910 (*Chas. A. Foster*).

21. *Charaxes lactetinctus ungemachi* Le Cerf f. *brunneus* Carpenter, ♂, holotype. South-west Abyssinia, Haeto river, 7° 48′ N. 35° 27′ E., 6900 ft., 24 January, 1927 (*A. W. Hodson*).

22. *Precis terea fumata* R. & J., ♂. South-west Abyssinia, below Gore, 8° 9′ N. 35° 33′ E., 6000 ft., 7 December, 1926 (*A. W. Hodson*).

23. *Precis octavia octavia* Cr., ♂. The pattern is more like that of the western *octavia* Cr. (cp. 25) than the eastern *natalensis* Stgr. (24), but the pink colour is nearly as bright as in the latter. South-west Abyssinia, locality as in No. 22, 25 December, 1926 (*A. W. Hodson*).

24. *Precis octavia natalensis*, ♀. South Africa, Mashonaland, Salisbury, 5000 ft., 1 March, 1899 (*G. A. K. Marshall*).

25. *Precis octavia octavia* Cr., ♂. Typical West African form. Sierra Leone.

26. *Pseudacraea eurytus* L. f. *youbdonis* Ung., ♀, neallotype. South-west Abyssinia, near Gacher (Gacheb) river, 7° 1′ N. 35° 22′ E., 3800 ft., 15 February, 1927 (*A. W. Hodson*).

All specimens in the Department of Entomology of the Oxford University Museum.

EXPLANATION OF PLATE XII.

FIG. 27. *Bematistes alcinoë nado* Ung., ♀, neallotype. South-west Abyssinia, Got river, 7° 42′ N. 34° 36′ E., 1700 ft., 15 November, 1925 (*A. W. Hodson*).

28. *Acraea servona* God. f. *digitata* Carpenter, ♂, holotype. South-west Abyssinia, Nado's Province, Gosh Kana, 6000 ft., 5 February, 1925 (*A. W. Hodson*).

29. *Acraea ungemachi* Le Cerf, ♀, neallotype. South-west Abyssinia, Nado's Province, Meti Chafe, 4560 ft., 4 February, 1925 (*A. W. Hodson*).

30. *Acraea zetes sidamona* R. & J., ♂. South-west Abyssinia, Pokodi, 7° 38′ N. 34° 42′ E., 1700 ft., 14 November, 1925 (*A. W. Hodson*).

31. *Acraea zetes rudolphi* Eltr., ♂, holotype. Kenya Colony, Marsabit, south-east of Lake Rudolf, October–November, 1927 (*V. G. L. Van Someren*).

32. *Acraea terpsichore* L. ab. *bankoides* Cptr., ♂, holotype. Underside. South-west Abyssinia, Shoa Ghimira Province, 21 January, 1925 (*A.W. Hodson*).

33. *Acraea maji* Carpenter, ♂, holotype. Underside. South-west Abyssinia, Maji Province, 7700 ft., 15 September, 1925 (*A. W. Hodson*).

34. *Acraea zetes oscari* Rthsch., ♂. Slightly transitional to *sidamona* (30) in outline of outer margin of fore-wing: the black spots also are transitional in size. South-west Abyssinia, Mocha district, Shaki river, 5800 ft., 22 February, 1925 (*A. W. Hodson*).

35. *Acraea zetes oscari* Rthsch., ♂. South-west Abyssinia, Anderacha, 7° 31′ N. 35° 25′ E., 7000 ft., 2 February, 1927 (*A. W. Hodson*).

36. *Acraea maji* Carpenter, ♂. South-west Abyssinia, Maji Province, 7700 ft., 15 September, 1925 (*A. W. Hodson*).

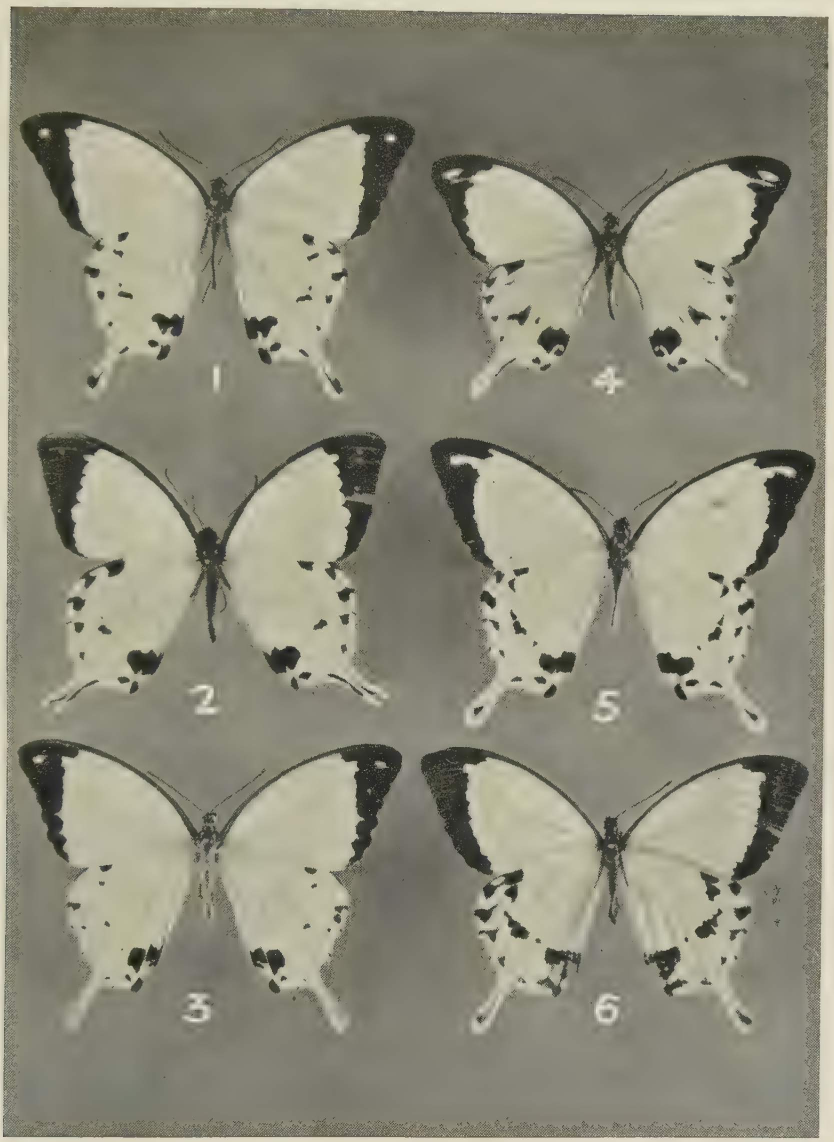
37. *Acraea* sp., ♀, probably *maji* Carpenter; underside. Upperside as in fig. 36. Data as fig. 36.

All specimens in the Department of Entomology of the Oxford University Museum.

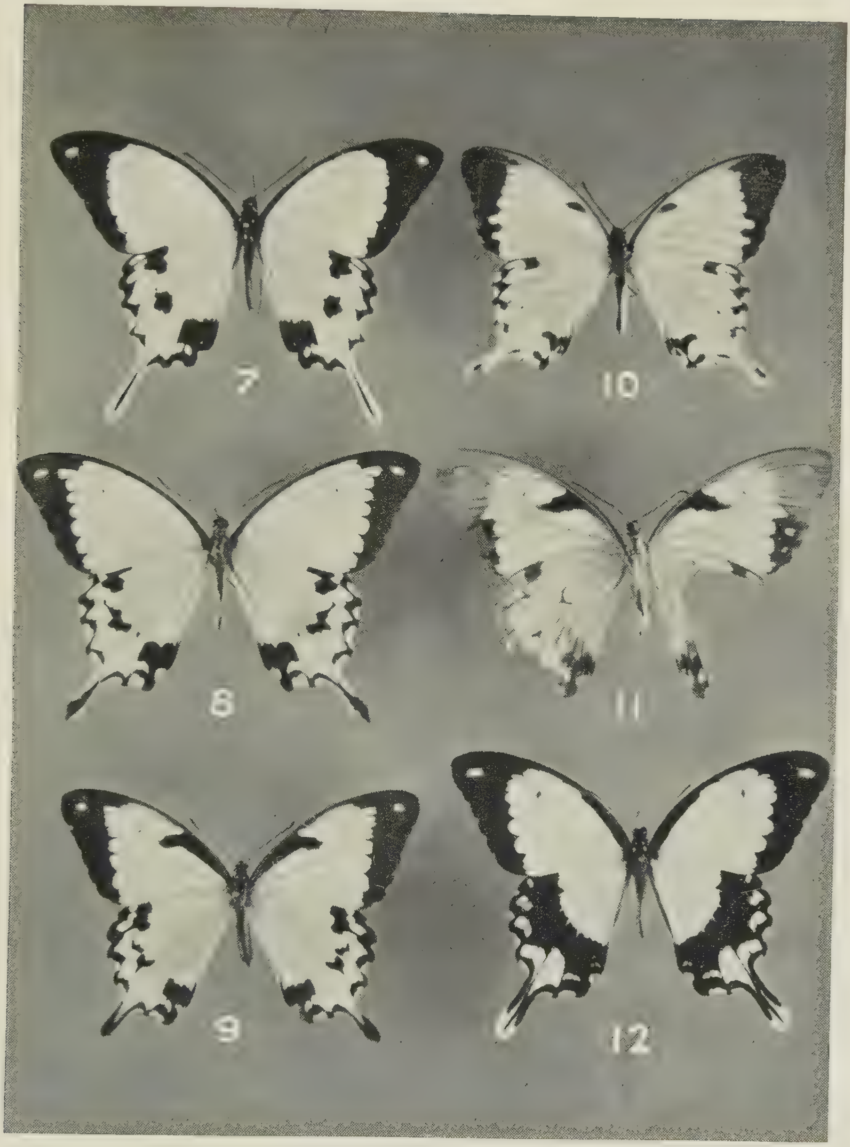
EXPLANATION OF PLATE XIII.

Map of Abyssinia and Eritrea above the 1500 metre contour line.

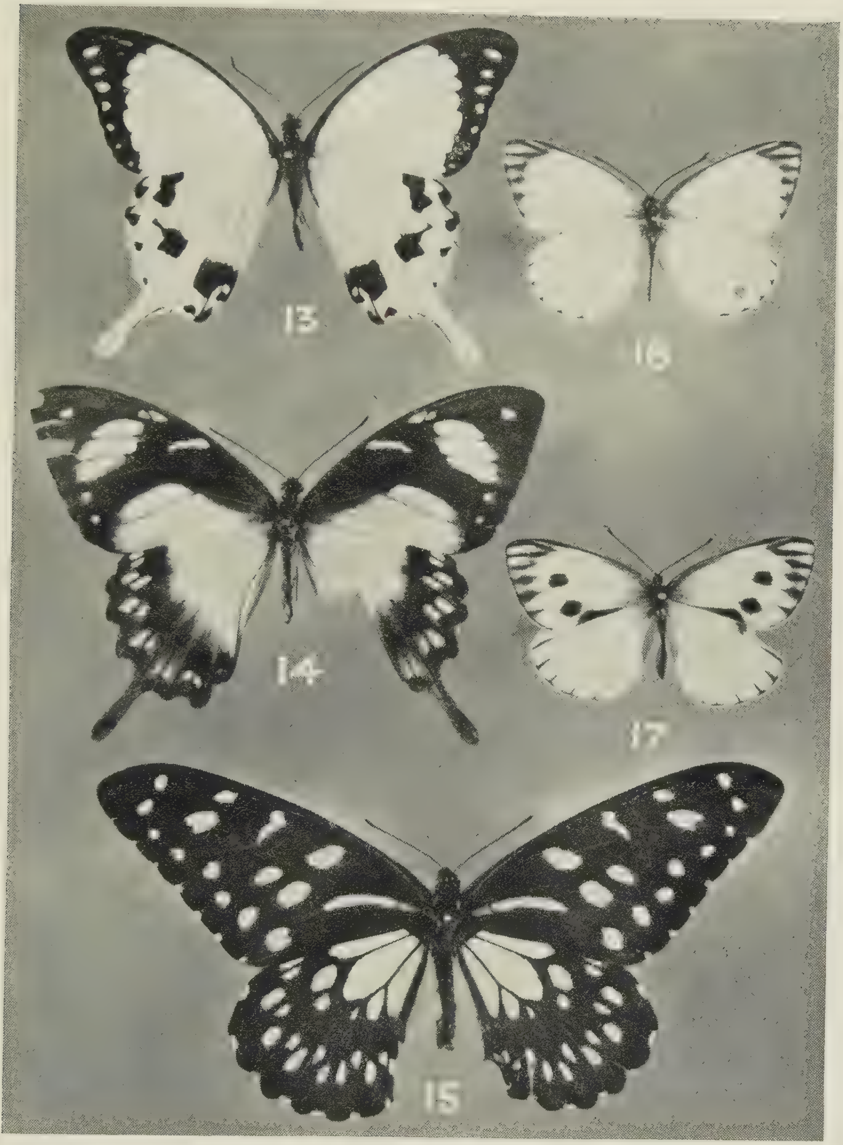
The area is bounded by the 1500 metre contour line, and this plate is made up from maps published by the Geographical Section, General Staff, No. 2871, 1922 and 1931. Names indicate places whence specimens have come and the dotted lines the routes of Erlanger, Neumann, Donaldson-Smith and Ungemach, whose collections have already been recorded, and Hodson whose collection is recorded in this paper.



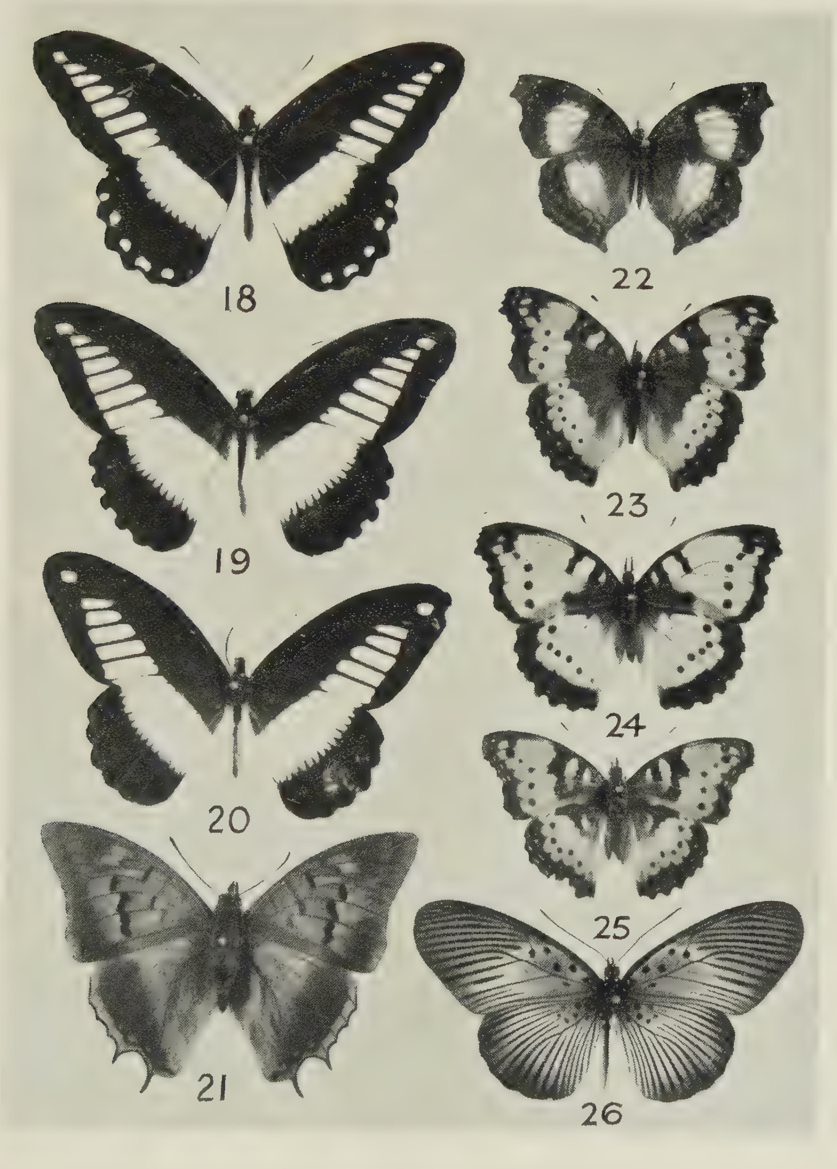
Rhopalocera of Abyssinia.



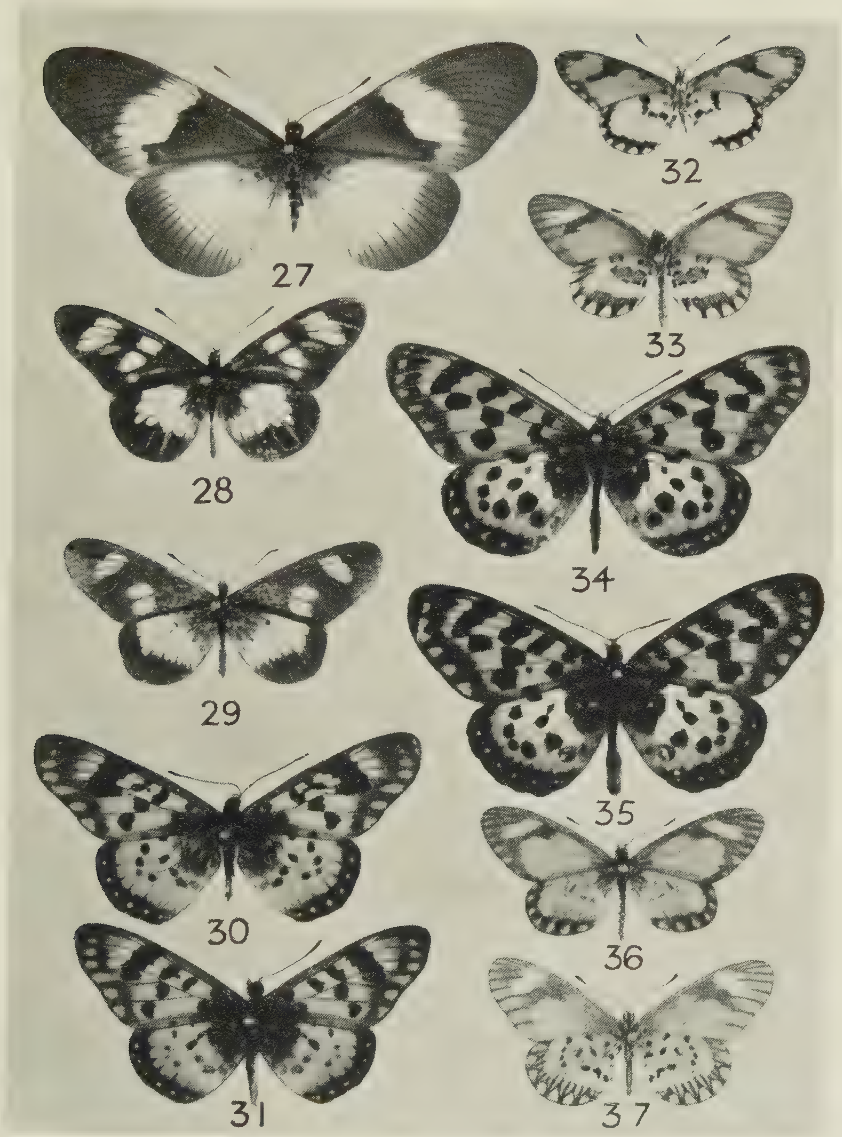
Rhopalocera of Abyssinia.


13
16
14
17
15

Rhopalocera of Abyssinia.


18
19
20
21
22
23
24
25
26

Rhopalocera of Abyssinia.


27
32
33
28
34
29
35
30
36
31
37

Rhopalocera of Abyssinia.

INDEX.

A

abadima, Acraea natalica, 386.
abessinica, Amauris lobengula, 354.
abyssinica, Antanartia, 372; *Appias sylvia*, 336; *Euchloë belemia*, 344; *Euphaedra sarita*, 361; *Eurytela hiarbas*, 366; *Glycestha gidica*, 337; *Melitaea*, 373.
abyssinicus, Charaxes etesippe, 358; *Euchrysops*, 401; *Papilio rex*, 319.
acaste, Colotis halimede, 345.
acerata, Acraea, 383.
achaemenes, Charaxes, 359.
acheloia, Byblia, 365.
Acleros, 408.
Acraea, 377–389.
actia, Precis, 369.
Actizera, 403.
admatha, Acraea, 389.
aequalis, Acraea lycoa, 378.
aestivalis, Byblia ilithyia f., 365.
aethiopica, Phalanta phalantha, 373.
aethiops, Acraea jodutta, 378; *Amauris niavius*, 352; *Mycalesis safitza*, 355; *Papilio*, 331; *Pontia daplidice*, 343; *Salamis parhassus*, 367.
africana, Melanitis leda, 354.
aganice, Bematistes, 375.
agatha, Neptis, 364.
agathina, Mylothris, 333.
agoye, Colotis, 349.
agrippinides, Belenois zochalia galla f., 339.
alba, Dixeia pigea f., 341.
alberta, Acraea cinerea, 380.
albida, Precis sophia infracta f., 370.
albinus, Danaus chrysippus f., 352.
albistriatus, Euchrysops, 401.
alcesta, Leptosia, 333.
alcinoë, Bematistes, 374–375.
alciope, Acraea, 377.
alcippus, Danaus chrysippus f., 352.
Alenia **gen.n.**, 409.
alicia, Acraea bonasia, 383.
aliena, Terias desjardinsi f., 351.
amanga, Axiocerses, 392.
amarah, Anthene, 395.
amatus, Colotis, 344.
Amauris, 352–354.
amelia, Colotis, 344.
amestris, Precis octavia f., 370.
amhara, Mylothris rhodope, 335.
anacardii, Salamis, 367.
anchises, Coeliades, 404.
Andronymus, 405.
angulata, Eurytela dryope, 366; *Precis chorimene* f., 368.
angulosa, Mycalesis, 356.
ansorgei, Kallima, 366.
antalus, Deudorix, 391.
Antanartia, 372.
antanossa, Zizeeria, 403.
antevippe, Colotis, 347.
anthedon, Hypolimnas d. dubia f., 367.
Anthene, 393–396; 435.
antheus, Papilio, 332.
antilope, Precis, 370.
antinorii, Acraea safie, 379; *Uranothauma*, 396.
antoto, Euchrysops, 401.
anynana, Mycalesis, 356.
apecida, Acraea cabira f., 382.
Aphniolaus, 392.
Appias, 336–337.
arabica, Eronia buqueti, 350.
areca, Acraea egina f., 387.
argenteomaculata, Axiocerses, 392.
Argiolaus, 392.
Argynnis, 373.
arnoldi, Papilio cynorta, 328–330.
asteris, Lepidochrysops, 399.
asterope, Ypthima, 356.
Aterica, 361–362.
Athysanota, 403.
aurivillii, Colotis halimede acaste f., 345.
aurivillius, Colias electa f., 351.
aurobrunnea, Anthene, 393.
aurota, Glycestha, 338.
Axiocerses, 392.
Azanus, 398.

B

bacchus, Colotis, 346.
balkis, Mylothris mortoni, 334.
bambana, Axiocerses, 392.
bankoides, Acraea terpsichore **ab.n.**, 384.
banyoana, Spindasis, 392.
Baoris, 406.
barkeri, Euchrysops, 400.
baronica, Deudorix, 390.
baronis, Papilio pylades, 332.
belemia, Euchloë, 344.
Belenois, 339–340.
Bematistes **gen.n.**, 374–376; 435.
bettoni, Celaerrhinus, 411.
bibulus, Lachnocnema, 390.
bicolor, Hamanumida daedalus f., 361.
birbiri, Papilio carchedonius, 332.
birbirica, Euxanthe eurinome, 357.
bisinuata, Terias hecabe senegalensis f., 350.
boeticus, Cosmolyce, 399.
boguensis, Glycestha creona, 338.
boisduvali, Crenis, 365; *Pseudacraea*, 362.
bonasia, Acraea, 383.
borbonica, Pelopidas, 406.
boschi, Leptomyrina, 393.
boueti, Charaxes, 359.
bowkeri, Stugeta, 391.
braesia, Acraea, 387.

brassicoides, Pieris, 343.
brenda, Terias hecabe senegalensis f., 350.
brevicornis, Gegenes letterstedti, 407.
brigitta, Terias, 351.
brimo, Lachnocnema, 390.
brunneus, Charaxes lactetinctus ungemachi **f.n.**, 359; *Euchrysops osiris* f., 401.
brutus, Charaxes, 358.
buqueti, Eronia, 350.
Byblia, 365–366.

C

cabira, Acraea, 382.
cabiroides, Acraea bonasia alicia f., 383.
cacta, Salamis, 367.
Cacyreus, 397.
caeca, Glycestha creona ab., 338.
caecilia, Acraea, 387.
caerulea, Deudorix, 390.
caffraria, Baoris fatuellus, 406.
calais, Colotis amatus, 344.
caldarena, Acraea, 387.
calypso, Belenois, 339.
camillus, Cyrestis, 364.
campa, Mycalesis, 355.
candiope, Charaxes, 360.
Caprona, 410.
carbonaria, Acraea e. encedon f., 380.
carchedonius, Papilio, 332.
cardui, Vanessa, 372.
casta, Colotis evenina f., 348.
castalis, Colotis vestalis, 344.
Castalius, 397.
castor, Charaxes, 358.
Catacroptera, 367–368.
Catopsilia, 350.
cebrene, Precis oenone, 371.
Celaenorrhinus, 411.
celimene, Colotis, 345.
ceryne, Precis, 370.
chalybe, Coeliades, 404.
Charaxes, 358–360.
charina, Dixeia, 342.
chilo, Acraea, 389.
Chondrolepis, 405.
chorimene, Precis, 368.
chrysippus, Danaus, 352.
chrysonome, Colotis, 344.
cinerea, Acraea, 380.
cinereus, Lepidochrysops, 400.
cissus, Cupidopsis, 402.
clelia, Precis, 371.
cleodora, Eronia, 349.
cloanthe, Catacroptera, 367.
coelestina, Anthene aurobrunnea f., 394; *Precis*, 369.
Coeliades, 404; 436.
Colias, 351.
colonna, Papilio, 333.
colorata, Everes micylus, 402.
Colotis, 344–349.
columbina, Phalanta, 372.
constantinus, Papilio, 330.
contrasta, Anthene, 394.
Cosmolyce, 399.
crameri, Byblia acheloia, 365.
crawshayi, Anthene, 395.
Crenis, 364–365.
creona, Glycestha, 338.
cretosus, Castalius, 398.
Cupidopsis, 402.
cyclopteris, Euchrysops, 401.
cygnophila, Eronia leda f., 349.
cynorta, Papilio, 328–330.
Cyrestis, 364.

D

daedalus, Hamanumida, 361.
daira, Acraea e. encedon f., 381; *Colotis*, 348.
damoclina, Hypolimnas d. dubia f., 367.
Danaus, 352.
daplidice, Pontia, 343.
dardanus, Papilio, 320–328.
darius, Amauris ochleides, 353.
debilis, Prosopalpus, 408.
definita, Anthene, 394.
demodocus, Papilio, 331.
dentigera, Belenois calypso, 339.
denuba, Eagris, 410.
depunctata, Belenois zochalia galla f., 339.
desjardinsi, Terias, 351.
desolata, Mycalesis, 355.
detecta, Pelopidas, 406.
Deudorix, 390–391; 435.
digitata, Acraea servona **f.n.**, 378.
diluta, Antanartia schaeneia, 372.
dinochares, Deudorix, 390.
diomus, Spialia, 408.
distractus, Euchrysops, 402.
diversa, Gnophodes parmeno, 354.
Dixeia, 340–342.
dixeyi, Dixeia, 340.
djaelaelae, Eretis, 410.
dohertyi, Deudorix, 391.
doleta, Ypthima, 357.
dorippoides, Hypolimnas misippus f., 367.
dorippus, Danaus chrysippus f., 352.
doubledayi, Acraea, 387.
doxo, Dixeia, 342.
dromus, Spialia, 408.
dryope, Eurytela, 366.
dubia, Hypolimnas, 367.

E

Eagris, 410.
echeria, Amauris, 354.
echerioides, Papilio, 328.
egina, Acraea, 387.
Eicochrysops, 402.
electo, Colias, 351.
eleusis, Euchrysops, 401.
elicola, Euchrysops, 401; *Papilio aethiops* ab., 331.
elma, Gomalia, 409.

elorea, Athysanota, 403.
encedon, Acraea, 380.
epaea, Bematistes, 376.
epaeoides, Pseudacraea eurytus f., 362.
epaphia, Appias, 336.
epijasius, Charaxes jasius, 358.
Eretis, 410.
eriphia, Pinacopteryx, 333.
eris, Colotis, 345.
erlangeri, Mylothris, 334.
Eronia, 349.
ertli, Castalius, 398.
esebria, Acraea, 378.
etesipe, Charaxes, 358.
etheocles, Charaxes, 360.
Euchloë, 344.
Euchrysops, 400.
Euphaedra, 360.
eupompe, Colotis, 346.
eurinome, Euxanthe, 357.
Euryphene, 360.
Eurytela, 366.
eurytus, Pseudacraea, 362.
evagore, Colotis, 348.
evarne, Colotis, 349.
evenina, Colotis, 348.
Everes, 402.
evippe, Colotis, 347.
evombaroides, Papilio antheus nyasae ab., 332.
expansa, Pseudacraea lucretia walensensis f., 364.

F

falkensteini, Uranothauma, 397.
fatuellus, Baoris, 406.
ferruginea, Pelopidas, 406.
ficedula, Myrina, 391.
flesus, Tagiades, 410.
florella, Catopsilia, 350.
forestan, Coeliades, 404.
formosa, Danaus, 352.
franciscae, Papilio rex, 319.
Freyeria, 402.
fumata, Precis terea, 368.
funebris, Mycalesis, 356.

G

gaika, Zizeeria, 403.
galami, Precis pelarga f., 369.
galene, Aterica, 361.
galenus, Celaenorrhinus, 411.
galla, Belenois zochalia, 339.
garega, Crenis, 365.
gaudens, Colotis, 344.
Gegenes, 407.
gelonica, Acraea peneleos, 379.
gemella, Pelopidas, 407.
gemmifera, Anthene, 395.
gerda, Dixeia charina liliana f., 342.
ghimirra, Cacyreus palemon, 397.
gidica, Glycestha, 337.
Glycestha, 337–339.
Gnophodes, 354.
godarti, Charaxes castor ab., 358.
Gomalia, 409.
grammicus, Tarucus, 397.
gussfeldti, Oboronia, 403.

H

hailo, Belenois calypso dentigera f., 340.
halimede, Colotis, 345.
Hamanumida, 361.
hanno, Coeliades, 404.
hansali, Charaxes, 358.
hapale, Terias, 350.
harpax, Axiocerses 392.
hatita, Hypolycaena, 391.
hecabe, Terias, 350.
hecate, Amauris, 354.
heliocaustus, Colotis pleione, 345.
Henotesia, 356.
here, Precis orithyia, 372.
herilus, Pardaleodes, 405.
hiarbas, Eurytela, 366.
hiemalis, Belenois calypso dentigera f., 340.
hiemis, Ypthima pupillaris paupera f., 357.
hintza, Castalius, 397.
hippocrates, Everes, 402.
hippomene, Antanartia, 372.
hodsoni, Anthene, 395; *Pieris b. brassicoides* **f.n.**, 343.
hollandi, Charaxes etheocles f., 360.
holtzii, Pelopidas, 406.
homochroa, Bematistes epaea, 376.
hyperbius, Argynnis, 373.
Hypolimnas, 366-367.
Hypolycaena, 391.
hypoxanthe, Glycestha, 337.

I

ilithyia, Byblia, 365.
immaculata, Coeliades immaculata **subsp.n.**, 404.
impura, Ypthima, 357.
inaequabilis, Euphaedra, 360.
inaria, Hypolimnas misippus f., 366.
incerta, Pardaleodes, 405.
indefinita, Anthene, 394.
infida, Glycestha creona boguensis f., 338.
infracta, Precis sophia, 370.
insignis, Acraea, 389.
ione, Colotis, 345.
isis, Castalius, 398.
ismenias, Argiolaus, 392.
Isoteinon, 408.
iterata, Pinacopteryx eriphia lacteipennis f., 333.
itonia, Ypthima, 357.
iturina, Acraea, 389.

J

jalone, Colotis ione f., 345.
januarii, Precis terea f., 368.

jasius, Charaxes, 358.
jesous, Azanus, 398.
jobates, Cupidopsis, 402.
jodutta, Acraea, 378.
jordani, Acraea, 386; *Precis coelestina* f., 369.
junius, Charaxes brutus, 358.

K

kaffana, Acraea perenna, 387; *Castalius ertli*, 398; *Crenis boisduvali*, 365; *Mylothris rüppellii kikuyuensis* f., 334.
kakana, Acraea, 389.
Kallima, 366.
karschi, Acraea cabira f., 382.
Kedestes, 407.
kenia, Mylothris rüppellii kikuyuensis f., 334.
kersteni, Anthene larydas, 395.
kikuyu, Anthene, 395.
kikuyuensis, Mylothris rüppellii, 334.
kostlani, Colias electo ab., 351.

L

labdaca, Libythea, 390.
lachesis, Pseudacraea eurytus f., 362.
Lachnocnema, 390.
lacteipennis, Pinacopteryx, 333.
lactetinctus, Charaxes, 359.
lactinatus, Castalius cretosus, 398.
laelius, Sarangesa, 410.
lara, Leptomyrina, 393.
larydas, Anthene, 395; *Papilio* (see *Anthene*).
latreillianus, Papilio, 332.
leda, Eronia, 349; *Melanitis*, 354.
lemolea, Spalgis, 393.
leodice, Precis pelarga f., 369.
leonidas, Papilio, 332.
Lepidochrysops, 399.
Leptomyrina, 393.
Leptosia, 333.
letterstedti, Gegenes, 407.
leucographa, Acraea admatha f., 389.
leucospilus, Papilio echerioides oscari f., 328.
leucotincta, Precis sophia infracta f., 371.
libya, Melanitis, 354.
Libythea, 390.
ligata, Catacroptera cloanthe, 368.
ligures, Anthene, 393.
lilacina, Lepidochrysops pterou, 400.
liliana, Dixeia charina, 342.
limnoria, Precis, 368.
lingeus, Cacyreus, 397.
livida, Anthene, 395.
lobengula, Amauris, 354.
lorti, Colotis, 346.
lucida, Zizeeria, 403.
lucidella, Sarangesa, 410.
lucretia, Pseudacraea, 363.
lugens, Eretis, 410; *Precis westermanni* f., 371.
lunulata, Anthene, 395.
lunulifer, Lepidochrysops cinerus, 400.
lusones, Anthene, 396.
Lycaena, 403.
Lycaenesthes (see *Anthene*).
lycioides, Acraea e. encedon f., 380.
lycoa, Acraea, 378.
lysimon, Zizeeria, 403.

M

mackenii, Acleros, 408.
macomo, Kedestes, 407.
maculata, Terias hecabe senegalensis f., 350.
madagascariensis, Precis orithyia, 371.
maderkal, Pararge, 356.
maevius, Henotesia perspicua f., 356.
maji, Acraea, **sp.n.**, 385–386.
malathana, Euchrysops, 401.
mangana, Spialia, 409.
mardania, Euryphene, 360.
marginatus, Charaxes tiridates, 359.
marnoana, Colias, 351.
marpessa, Neptis saclava, 364.
marshalli, Terias desjardinsi f., 351.
masai, Euchrysops, 402.
mathias, Pelopidas, 407.
mauensis, Euchrysops, 400.
mediterraneae, Tarucus, 397.
medon, Euphaedra, 361.
melanarge, Pinacopteryx eriphia lacteipennis f., 333.
Melanitis, 354.
meleagris, Hamanumida daedalus f., 361.
melicerta, Neptis, 364.
Melitaea, 373.
menelik, Coeliades, 404.
messapus, Eicochrysops, 402.
Metisella, 408.
micans, Pelopidas, 406.
microps, Antanartia columbina, 372.
micylus, Everes, 402.
midas, Metisella, 408.
milonia, Precis, 369.
milyas, Micalesis, 355.
mima, Hypolimnas dubia, 367.
mimo-ras, Pseudacraea eurytus f., 363.
mirza, Azanus, 399.
misippus, Hypolimnas, 366.
mixta, Glycestha creona boguensis f., 338.
mollitia, Mycalesis, 355.
mombasae, Stugeta bowkeri, 391.
monteironis, Acraea esebria, 378.
moriqua, Azanus, 398.
mortoni, Mylothris, 334.
motozi, Sarangesa, 410.
musagetes, Anthene, 393.
Mycalesis, 355–356.
Mylothris, 333–336.
Myrina, 391.

N

Nacaduba, 399.
nado, Bematistes alcinoë, 374–375.

natalensis, Acraea cabira f., 382; *Azanus*, 398.
natalica, Acraea, 386.
neanthes, Charaxes zoolina f., 360.
nebulosa, Mycalesis funebris, 356; *Salamis anacardii*, 367.
necoda, Acraea encedon, 381.
negus, Lepidochrysops, 400.
nemetes, Neptis, 364.
neobule, Acraea, 389.
Neptidopsis, 366.
Neptis, 364.
neumanni, Acraea safie antinorii f., 380; *Argynnis hyperbius*, 373; *Danaus formosa*, 352; *Euphaedra preussi*, 361.
niavius, Amauris, 352.
nilotica, Euchrysops malathana, 401.
nireus, Papilio, 330.
niveicornis, Chondrolepis, 405.
niveocincta, Euchrysops reducta, 401.
noctula, Pelopidas, 406.
nottoana, Eagris, 410.
nubifer, Uranothauma, 396.
nuda, Acraea ungemachi f., 379.
numenes, Charaxes, 359.
nupta, Leptosia alcesta f., 333.
nuptilla, Leptosia alcesta, 333.
nyasae, Papilio antheus, 332.
nyasana, Liptena, 390.

O

obliterata, Eagris denuba, 410.
Oboronia, 403.
obscurata, Deudorix caerulea, 390.
obtusa, Neptis nemetes, 364.
obumbrata, Gegenes, 407.
occidentalium, Crenis, 364.
ocellatus, Colotis phisadia, 344.
ochleides, Amauris, 353.
octavia, Precis, 370.
oculus, Lepidochrysops parsimon, 400.
oenone, Precis, 371.
omphale, Colotis, 347.
omphaloides, Colotis omphale f., 347.
oncaea, Acraea, 387.
ophione, Neptidopsis, 366.
orbona, Appias epaphia, 337; *Dixeia*, 341.
oribazoides, Papilio aethiops f., 331.
orientalis, Bematistes aganice, 375.
orientis, Mycalesis funebris, 356.
orina, Acraea, 380.
orineta, Acraea orina, 380.
orithyia, Precis, 371.
oscari, Acraea zetes, 388; *Papilio echerioides*, 328.
osiris, Euchrysops, 401.
otacilia, Anthene, 394.

P

pachalica, Hypolycaena, 391.
pagenstecheri, Charaxes pelias, 358.
palemon, Cacyreus, 397.
pallene, Aphniolaus, 392; *Colotis*, 348.
Papilio, 319–333.
Pararge, 356.
Pardaleodes, 405.
Pardopsis, 390.
parhassus, Salamis, 367.
parmeno, Gnophodes, 354.
parsimon, Lepidochrysops, 400.
patricius, Lepidochrysops, 400.
paupera, Ypthima pupillaris, 357.
pavonis, Mycalesis, 355.
peculiaris, Lepidochrysops, 399.
pelarga, Precis, 369.
pelias, Charaxes, 358.
Pelopidas, 406.
peneleos, Acraea, 379.
Pentila, 390.
perenna, Acraea, 387.
perochrata, Euphaedra preussi, 361.
perspicua, Henotesia, 356.
petiverana, Danaus, 352.
Phalanta, 372–373.
phalantha, Phalanta, 373.
pharsalus, Acraea, 382.
phidyle, Sarangesa, 411.
philander, Andronymus, 405.
philippsi, Colotis evarne f., 349.
philippus, Hypolycaena, 391.
phisadia, Colotis, 344.
phlaeas, Lycaena, 403.
phlegyas, Colotis ione f., 345.
phoebus, Charaxes, 358.
phoenicis, Anthene, 396.
piaggiae, Argiolaus, 392.
Pieris, 343.
pigea, Dixeia, 341.
pillaana, Caprona, 410.
Pinacopteryx, 333.
pisistratus, Coeliades, 404.
Planema (see *Bematistes*).
platydema, Hypolimnas salmacis, 367.
pleione, Colotis, 345.
plinius, Syntarucus, 399.
poggei, Bematistes, 376.
polinice, Byblia ilithyia f., 365.
polydialecticus, Lepidochrysops, 400.
Pontia, 343.
poultoni, Acraea e. encedon f., 381.
Precis, 368–372.
preussi, Euphaedra, 361.
princeps, Anthene, 395.
Prosopalpus, 408.
protoclea, Charaxes, 359.
protomedia, Colotis, 345.
protracta, Pseudacraea lucretia walensensis f., 364.
pseudacaste, Colotis eupompe f., 346.
Pseudacraea, 362–364.
pseudegina, Acraea natalica abadima f., 386.
pseudonireus, Papilio nireus, 330.
pseudophlaeas, Lycaena phlaeas, 403.
pterou, Lepidochrysops, 400.
pudorella, Acraea, 387.

pulchra, Syntarucus, 399.
punctatissima, Pardopsis, 390.
punctatus, Oboronia, 403.
punctulata, Isoteinon, 408.
puniceus, Colotis, 346.
pupillaris, Ypthima, 357.
pupillata, Eronia leda ab., 349.
pusillus, Euchrysops, 401.
pylades, Papilio, 332.
pyrene, Catopsilia florella f., 350.
pyrrhopterus, Colotis omphale f., 347.

Q

quirina, Acraea, 390.

R

raffrayi, Belenois, 339.
ras, Bematistes poggei, 376; *Pentila nyasana*, 390.
rectans, Charaxes boueti, 359.
reducta, Euchrysops, 401.
resplendens, Castalius hintza, 397.
rex, Papilio, 319.
rhodina, Acraea pharsalus, 382.
rhodope, Mylothris, 335.
rileyi, Acraea doubledayi f., 387.
rothschildi, Anthene, 395.
rubricosta, Mylothris, 335.
rüppellii, Mylothris, 334.

S

saalmülleri, Dixeia, 341.
sabina, Appias, 336.
saclava, Neptis, 364.
saddacus, Anthene, 393.
safie, Acraea, 379.
safitza, Mycalesis, 355.
sagala, Mylothris, 336.
Salamis, 367.
salmacis, Hypolimnas, 367.
sandace, Mycalesis, 355.
sandaster, Alenia, 409.
Sarangesa, 410.
sarita, Euphaedra, 361.
sayonis, Pseudacraea boisduvali f., 362.
schaeneia, Antanartia, 372.
schecana, Acraea alciope, 377.
selousi, Mycalesis desolata, 355.
senegalensis, Pelopidas borbonica, 406; *Terias hecabe*, 350.
servona, Acraea, 378.
severina, Glycestha creona, 338.
sganzini, Acraea e. encedon f., 380.
sichela, Nacaduba, 399.
sidamona, Acraea zetes, 388.
siginna, Acraea insignis, 389.
silas, Argiolaus, 392.
silenus, Myrina, 391.
simana, Dixeia charina, 342.
simplex, Colotis antevippe f., 347.
simplicia, Ypthima, 357.
simplici-ocellata, Ypthima asterope ab., 357.
sipylus, Colotis evenina f., 348.
sisenna, Papilio, 332.
solilucis, Belenois, 340.
somalicus, Charaxes brutus, 358.
somalina, Spindasis, 392.
sophia, Precis, 370.
sotikensis, Acraea, 383.
Spalgis, 393.
Spialia, 408.
Spindasis, 392.
spio, Spialia, 408.
steckeri, Amauris echeria, 354.
stellata, Actizera, 403.
stictica, Amauris hecate, 354.
Stugeta, 391.
subeida, Belenois, 339.
subvariegatus, Lepidochrysops, 400.
sudanensis, Appias sylvia, 336; *Belenois calypso*, 340.
suquala, Anthene, 395.
sybaris, Tarucus, 397.
sylvanus, Anthene, 394.
sylvia, Appias, 336.
Syntarucus, 399.

T

Tagiades, 410.
Tarucus, 397.
taveta, Precis limnoria, 369.
temora, Salamis, 367.
tenella, Acraea acerata f., 383.
terea, Precis, 368.
Terias, 350–351.
terpsichore, Acraea, 384–385.
terra, Pseudacraea eurytus f., 362.
thalassina, Eronia, 349.
theogone, Colotis omphale f., 347.
theophane, Aterica galene, 362.
theophrastus, Tarucus, 397.
thysa, Belenois, 340.
tiridates, Charaxes, 359.
tirikensis, Pseudacraea eurytus f., 362.
tolosa, Mycalesis vulgaris f., 356.
tricolor, Belenois thysa f., 340.
trochylus, Freyeria, 402.
tsadicus, Metisella, 408.
tugela, Precis, 369.
tukuoa, Precis ceryne f., 370.

U

ubaldus, Azanus, 399.
ugandae, Hypolycaena hatita, 391.
umanus, Papilio latreillianus, 332.
umbrata, Acraea natalica abadima f., 386.
umbrina, Crenis, 365.
ungemachi, Acraea, 379; *Charaxes lactetinctus*, 359.
Uranothauma, 396.

V

Vanessa, 372.
varanes, *Charaxes*, 360.
velleda, *Colotis amelia*, 344; *Neplidopsis ophione*, 366.
velutina, *Mycalesis safitza aethiops* f., 355.
venata, *Dixeia doxo*, 342.
venosus, *Colotis*, 345.
vesta, *Colotis*, 344.
vestalis, *Colotis*, 344.
vidua, *Dixeia orbona*, 341.
vinidia, *Acraea acerata* f., 384.
vologeses, *Charaxes varanes*, 360.
vulgaris, *Byblia a. acheloia* f., 365; *Mycalesis*, 356.

W

walensensis, *Pseudacraea lucretia*, 363.
wallengreni, *Kedestes*, 407.
westermanni, *Precis*, 371.
westwoodi, *Glycestha gidica*, 337.
wilsoni, *Anthene*, 393.

Y

youbdonis, *Pseudacraea eurytus* f., 363.
Ypthima, 356–357.

Z

zebra, *Spialia*, 408.
zeno, *Zenonia*, 405.
Zenonia **gen.n.**, 405.
zephyrus, *Colotis agoye*, 349.
zetes, *Acraea*, 388.
Zizeeria, 403.
zochalia, *Belenois*, 339.
zoë, *Terias brigitta* f., 351.
zoolina, *Charaxes*, 360.
zoraida, *Belenois subeida*, 339.

R

THE BIOLOGY AND DISTRIBUTION OF *RHIZOPERTHA DOMINICA* (FAB.)

By C. Potter, B.Sc.

[Read 1st May, 1935.]

With Twenty-five Text-figures.

Contents.

	PAGE
Introduction	449
Nomenclature	450
Geographical Distribution	450
Food and Feeding Habits	453
Life-History and Morphology	455
Systematic Position	467
Natural Enemies	478
Summary	479
List of Papers referred to	479

Introduction.

A considerable number of authors have referred to *Rhizopertha dominica* (Fab.), but only a few have published any detailed work on this insect.

The majority of the references are to records of its occurrence or to recommendations of methods for its destruction.

Detailed work has been done by Chittenden (1911), Barnes and Grove (1916) and Schwardt (1933) on the biology, Chittenden and Schwardt being concerned with the life-history and habits of the insect in America, and Barnes and Grove with its occurrence as a serious pest of grain in India.

The systematic position of the adult beetle has been dealt with by Lesne (see bibliography) in a number of publications, and that of the mature larva has been recently dealt with by Gardner (1933), and in this paper some of the work which I had done on this stage of the insect was anticipated.

I began work on this insect in order to collect and collate the information already available and to fill in the more obvious gaps in our knowledge. A considerable amount of time was spent in working out the distribution in detail in order to ascertain the extent to which climatic conditions govern its area of distribution and to obtain more data on which to assess its potentiality as an insect injurious to stored products in warehouses and similar environments. A study was made of the life-history under controlled conditions in the laboratory, and a brief account is given of the separate larval instars. The mature larvae and adult are described in more detail.

No description had previously been made of the separate instars and accordingly these had not been distinguished. A difficulty that has previously handicapped work on *R. dominica* was the lack of knowledge of its external structure and in particular of the characters of structure distinguishing the sexes. A sexual dimorphism between the male and female pupae is here described for the first time.

In view of the increasing importance attached by entomologists to the genitalia of the Coleoptera as a basis of their classification, a detailed study of these structures in the adult male and female has been made and an account given of their taxonomic significance.

An account of the synonymy of the insect is given from the literature and from an examination of the material available in the collection of the British Museum (Natural History). A complete list of the food materials on which it has been recorded is given for the first time, and some experiments were made to find out if it would attack living plants.

The control measures advocated for *R. dominica* are not dealt with here. The rapid advance of the science of control measures for pests of stored products makes any statements of this kind rapidly out of date, and furthermore in practice control measures must refer to particular circumstances.

I am indebted to Professor J. W. Munro of the Entomology Department of the Imperial College of Science, in whose department and under whose direction the work was carried out, for a number of suggestions, and to Dr. O. W. Richards, also of that Department, for reading through and criticising the manuscript.

NOMENCLATURE.

Rhizopertha Stephens (1830).
Synodendron dominicum Fabricius (1792).
Rhizopertha dominica Lesne (1896).
Synodendron pusillum Fabricius (1798).
Rhizopertha pusilla Stephens (1830); Lucas (1849); Wollaston (1854); Lacordaire (1857); Redtenbacher (1858); Duval (1859–63); Duval et Fairmaire (1859–63); Leconte (1861–62); Weir (1874); Fauvel (1878); Taschenberg (1879); Fitch (1879); Billups (1879); Cotes (1889); Cotes (1891); Zoufal (1894); Cotes (1896); Kiesenwetter (1898); Willcocks (1909).
Dinoderus pusillus Horn (1878); Riley (1882); Gorham (1883); Leconte and Horn (1883); Hamilton (1894).
Apate pusilla Fairmaire (1850); *Ptinus fissicornis* Marsham (1802); *Ptinus piceus* Marsham (1802); *Apate rufa* Hope (1845–47); *Dinoderus frumentarius* Motschulsky (1857); *Rhizopertha rufa* Waterhouse (1888).

This list of synonyms is derived from the literature. An examination of the specimens in the British Museum showed that *Bostrychus moderatus* Walk., must be added to this list since the type is undoubtedly a specimen of *Rhizopertha dominica*.

Lesne (1896) first recorded the species as *Rhizopertha dominica* and in 1897 he published a full description and bibliography under this name.

The specific names *dominica* and *pusilla* are given for *Rhizopertha* in the catalogues of Reitter (1906) and Leng (1920), but *Rhizopertha dominica* is the name now generally used. The popular names of *R. dominica* in economic literature are the " Lesser Grain Borer " and the " Australian wheat weevil."

GEOGRAPHICAL DISTRIBUTION.

R. dominica feeds on stored vegetable products. It has therefore been transported to all parts of the world and there are records of its occurrence in a very large number of places.

It is recorded as being cosmopolitan by the following authors :—Fauvel 1878, Horn 1878, Lesne 1898 and 1911, Chittenden 1911, Burgeon 1930.

Duval 1856 remarked that it tends to become cosmopolitan, and Lacordaire 1857 stated that it is partly cosmopolitan.

Lesne 1897, 1900–06, stated that it is cosmopolitan in warmer regions and later (Lesne 1910–11 and 1932) that it is cosmopolitan in tropical regions.

All these terms are vague and the definition given below is perhaps more useful.

Records of distribution show that the beetle has been introduced all over the world. What is more difficult to define is the areas where it is capable of continuing its life cycle from year to year without dying out. It is presumed that this is the basis of Lesne's description of its distribution.

R. dominica has been recorded in the following areas which probably provide conditions favourable for its continued survival:—Algeria (Lucas 1849), recorded as living under bark out of doors; Madeira (Wollaston 1854); n. east Africa (Lesne 1897, 1898, 1900–06, 1924 (*b*), 1929); n. west Africa (Lesne 1924 (*b*)); central Africa (Burgeon 1930); Egypt (Lesne 1900–06, Willcocks 1909); possibly Mesopotamia (Lesne 1900–06); southern United States (Tucker 1908). (Tucker is the first to cite it as an established pest in the U.S.A.); New South Wales (Gurney 1918, Froggatt 1918). Froggatt (*loc. cit.*) stated that the insect is quiescent in stacks of grain during the winter, except on sunny days, when the beetles may be seen to crawl over the stacks. *R. dominica*, of which one of the popular names is the "Australian wheat weevil," was thought to be so important in New South Wales that it was put on the list of scheduled pests in 1925 (N.S.W. Govt. Gaz. 97).

The permanent establishment of the beetle in Japan is recorded by Takahashi (1931 *a* and *b*).

It is probably established in Cochin China (Lesne 1898 and Ghosh 1925). From records of its occurrence in China (Lesne 1900–06, Hope 1845–47), and in products from China (Maskew 1920, Maskew and Strong 1920), it may also be regarded as resident there.

Finally, it is one of the most serious pests of stored cereals in India.

The above list comprises all the areas in which, as shown by the records, the insect is firmly established. It is interesting to note that all these areas are included in the belt between lat. 40° N. of the equator and lat. 40° S. of the equator.

All the other records of the insect may refer to its occurrence in freshly imported material or in places that were artificially heated.

The original home of *R. dominica* is not known for certain, but the balance of opinion is that it is India or the Indian subregion. (Fabricius 1798; Marsham 1802; Lesne 1900–06; Chittenden 1911). Lacordaire 1857 stated that its native country appears to be the north of Europe, but this is contradicted by Redtenbacher 1858 and Lesne 1900–06, and is almost certainly erroneous. The theory that India or its neighbourhood is the original home of *R. dominica* is supported by the fact that this area is considered to be the focus of a large number of species of Bostrychids. (Lesne 1924 (*a*).)

A list of the records of the occurrence of *R. dominica* is given below under the headings of the zoogeographical regions of Wallace. The records were classified in this way to allow the main areas of distribution to be seen at a glance. Where more than one record has been made for a small area, the earliest reference considered reliable has been selected.

Cosmopolitan:—Duval (1856); Lacordaire (1857); Fauvel (1878); Horn (1878); Lesne (1897 and 1898); Chittenden (1911); Macdougall (1925); Burgeon (1930).

Palaearctic Region:—

  Europe:—Wollaston (1854).

European Subregion :—
England :—Stephens (1830). Scotland :—Macdougall (1925). Germany :—Kiesenwetter (1898). France :—Lesne (1898). Austria :—Redtenbacher (1858). Russia :—Bekman (1929).
Mediterranean Subregion :—
Italy :—Lunardoni (1889). Madeira :—Wollaston (1854). Egypt :—Lesne (1900–06). Mesopotamia :—Lesne (1900–06). Africa (Algeria) :—Lucas (1849). Cyprus :—Lesne (1898).
Manchurian Subregion :—
China :—Lesne (1900–06). Japan :—Takahashi (1931 *a* and *b*).
Ethiopian Region.
Malagasy Subregion :—
Seychelles Islands :—Dupont (1916). Mauritius :—Lesne (1932). Madagascar :—Lesne (1932). La Reunion Island :—Lesne (1932).
West African Subregion :—
French Guinea :—Lesne (1924 (*b*)). Volta Basin :—Lesne (1924 (*b*)). Sierra Leone :—Lesne (1924 (*b*)). Ivory Coast :—Lesne (1924 (*b*)). N. Nigeria :—Lesne (1924 (*b*)). Belgian Congo :—Burgeon (1930).
East African Subregion :—
Eritrea :—Lesne (1898). French Somaliland :—Lesne (1897). Niger Basin :—Lesne (1924 (*b*)). Upper Senegal :—Lesne (1924 (*b*)). Middle Italian Somaliland :—Lesne (1929). Sokotra Island :—B.M. Coll. * Aden :—B.M. Coll.
Oriental Region.
Indo-Malayan Subregion :—
East Indies :—Motschulsky (1857). Java :—Lesne (1898). Borneo :—Lesne (1898). W. Sarawak :—B.M. Coll. Penang :—B.M. Coll. Philippine Islands :—B.M. Coll. Singapore :—B.M. Coll.
Indo-Chinese Subregion :—
Cochin China :—Lesne (1896). Cambodia :—Lesne (1896). Burma :—Lesne (1896). Andaman Islands :—B.M. Coll. Siam :—B.M. Coll. French Indo-China :—B.M. Coll.
Indian Subregion :—
India :—Marsham (1802). Eastern India :—Fabricius (1798). Southern India :—Fletcher (1914). Calcutta :—Cotes (1889). Madras :—Cotes (1891). Bombay :—Stebbing (1903). Punjab :—Barnes and Grove (1916). Assam :—B.M. Coll. Sikkim :—B.M. Coll.
Ceylonese Subregion :—
Ceylon :—B.M. Coll.
Australian Region.
Austro-Malayan Subregion :—
Celebes :—Lesne (1898). New Guinea :—B.M. Coll.
Australian Subregion :—
New South Wales :—Froggatt (1918). Fremantle :—B.M. Coll.
Polynesian Subregion :—
Tahiti :—Fairmaire (1850). Hawaii :—Chittenden (1911). Honolulu :—Ehrhorn (1919). Fiji :—Simmonds (1923). Gilbert Islands :— B.M. Coll.
Neotropical Region :—
Central America :—Fabricius (1792).
Chilian Subregion :—
Argentine :—Strong (1921).

---

* British Museum Collection.

Brazilian Subregion :—
S. Paulo :—Zacher (1932). Pernambuco :—B.M. Coll.
Mexican Subregion :—
Jalapa and Vera Cruz :—Gorham (1883). Honduras :—Gorham (1883).
Antillean Subregion :—
Cuba :—Motschulsky (1857). Porto Rico :—Chittenden (1919).
Nearctic Region :—
America :—Neiswander (1931). N. America :—Leconte (1861–62). Southern U.S.A. :—Tucker (1908). Gulf States :—Back and Cotton (1931).
Californian Subregion :—
California :—Doane (1919).
Rocky Mountain Subregion :—
Texas :—Back and Cotton (1922). Kansas :—Back and Cotton (1922). Oklahoma :—Back and Cotton (1922). Arizona :—Horn (1878).
Alleghany Subregion :—
Pennsylvania :—Horn (1878). N. York City :—Chittenden (1911). Washington, D.C. :—Chittenden (1911). Iowa :—Chittenden (1911). Illinois :—Chittenden (1911). S. Carolina :—Chittenden (1911). New Jersey :—Chittenden (1911). Louisiana :—Back and Cotton (1922). Arkansas :—Isley, Schwardt and Baerz (1930–31).
Canadian Subregion :—
Canada :—Hamilton (1894).

FOOD AND FEEDING HABITS.

R. dominica has been reported on a wide variety of foods chiefly cereals. Its habit of feeding on stored grain and similar starchy products has rendered it economically important.

The following is a list of the substances which have been recorded as forming its food :—

Grains of all kinds, including flour. (Recorded by a large number of authors.) Chick peas (Back and Cotton 1924). Edible bulbs and the bread made from them (Chittenden 1911). Wild prairie turnip (Chittenden 1911). Seeds of white lotus, *Nymphaea lotus*; product of Abyssinian banana, *Musa ensete*; wood of rice boxes; pearl millet, *Pennisetum typhoideum*; horse collar stuffed with rye straw, both leather and stuffing (Chittenden 1911). Sorghum or Cholam seed, *Sorghum vulgare* (Cotes 1891). Lentils (Dupont 1916). Army biscuits (Durrant and Beveridge 1913). Ships biscuits (Fauvel 1878, quotes de Leseleuc). Wood of packing cases (Froggatt 1918). Stored drugs (Froggatt 1918). Working through mud-plaster (Fletcher and Ghosh 1921). Cumbu ears (Fletcher 1914). Wood of sugar casks (Gorham 1883). Wheat ear in the field (Gurney 1918). Malt barley (Ghosh 1925). Pulse (Kunhi-Kannan 1919). Unworked wood (Lesne 1897, quoting Dr. Billet). Various woods, unidentified (Lesne 1910–11). Wood of liquorice (Lesne 1924 (*b*), quoting V. Mayet). Living wood, probably *Quassia* spp. (Lesne 1924 (*b*)). Tamative flour (Lesne 1924 (*b*), quoting Mathiaux). Dried potato, cornflour, papers, fruits of *Trapa bispinosa* (Lesne 1924 (*b*), quoting Fletcher and Ghosh 1921). Under bark of *Quercus suber* and *Cytisus spinosus* (Lucas 1849). Grain, first record (Marsham 1802). Roots (Marsham 1802). Rice (Motschulsky 1857). Beans, pumpkin seed, tamarind seed (Maskew and Strong 1920). Haricot beans (Macdougall 1925). Cork (Riley 1882). Dead wood (Stebbing 1903). Millet, macaroni

(Willcocks 1922). Powdered arrowroot (Wollaston 1854). Turkey rhubarb (Wollaston 1854, quoting Kirby and Spence). Tapioca roots (*Manihot utilissima*), rusk (Zacher 1930). Wood of *Artocarpus hirsutus* (Gardner 1933).

Lesne (1911), in an account of the feeding habits of the Bostrychids, stated that they are, in general, wood eaters in both the larval and adult stages, attacking standing dead wood or wood recently fallen. A number of species are not confined to a single species of plant and some are remarkably polyphagous in this respect. There seems little doubt that *R. dominica* originally fed solely on wood, probably living wood. Lesne (1924 (*b*)) records having seen a pair working at a communal gallery on a tree, probably *Quassia* spp., in French Guinea, and Lucas (1849) has recorded it under the bark of *Quercus suber* and *Cytisus spinosus.* More recently Gardner (1933) records a long series bred from wood of *Artocarpus hirsutus.* The species of tree or shrub that was the original host of *R. dominica* cannot definitely be ascertained, since, in addition to the above records, it is reported as attacking various unidentified woods (Lesne 1910–11). A record of its occurrence on wheat ear in the field (Gurney 1918) may be regarded as a secondary adaptation. vii 85

In order to obtain experimental evidence of its capacity to attack the living plant and to find out whether some part of the plant other than the seed was liable to attack, a maize seed was sown in a pot and the young plant sleeved with some adults of *R. dominica.* The beetles attacked the plant at ground level only. The place of oviposition was not found, but later a full-grown larva was found in the stem. This shows that not only are the seeds of cereals susceptible to damage in the field, but it is possible that the vegetative tissues of the plant may be attacked.

To obtain further data on the question of the habits of *R. dominica* when feeding on wood, some beetles were placed on bamboo; freshly-cut cane obtained from the Royal Botanic Gardens, Kew, was put in a jar together with some old cane. The wood bamboo was chosen because species of *Dinoderus*, the genus most closely allied to *Rhizopertha*, bore into cane. The culture was kept in an incubator at 25° C. and approximately 65% relative humidity; the beetles attacked both the old and the new bamboo, but showed a preference for the new cane. They did not bore into the outer hard cane, but entered at the cut ends, and galleries were made in the softer material inside, and in the pith. The egg was deposited in a little niche in the inner soft wood. A full-grown larva was found in the wood, but the beetles died off after several months. It is possible that they might live in canes growing in the field under suitable conditions.

R. dominica has excited most interest as a pest of stored grain. It is considered as a major pest in India, the Argentine, the United States of America and New South Wales.

Grain badly attacked by the beetle may be hollowed out until only a thin shell remains. Several beetles may be found in one grain of maize; four have frequently been found and this number is often exceeded.

It has been stated that the larvae of the beetle are unable to attack the intact grain and that they can only feed on grains that are damaged. To test this statement, a maize grain was carefully examined and found to be intact; this grain was isolated with two eggs in a tin. Five days later the eggs hatched but the larvae did not at once enter the grain. Four days later it was found that both larvae had entered the grain by way of the hard brown testa, which was resting on the bottom of the tin. This showed that the first-stage larvae, which are elongate and not curved, are capable of attacking intact grain. The capability of the succeeding larval stages to penetrate grains was not tested;

with the possible exception of the second-stage larva, it is highly improbable that any of the other stages have any considerable powers of penetration of loose grain owing to their permanently flexed posture and their limited powers of locomotion, although it has been found that nearly full-grown larvae are capable of penetrating the cork of the tube in which they are kept. This they are enabled to do if a crevice allows of their obtaining purchase.

THE LIFE-HISTORY AND MORPHOLOGY.

Source of Material and Methods.

The material for the experiments was obtained from Professor Munro of the Imperial College of Science and Technology. The original source of the material was the Victoria mills, Wellingborough, where the beetles were found in and outside sacks of mixed seed on August 1st, 1928.

As many details as possible, in the morphological work, were obtained from observation or examination of living specimens, since any method of killing was liable to cause distortion. The most satisfactory method of killing primary larvae was found to be by dropping them into hot 90% alcohol. For microscopic details, mounts were made in canada balsam, glycerine, euparol or carbolic acid. A saturated solution of carbolic acid in absolute alcohol was frequently used for studying microscopic details, since it has the property of dehydrating, clearing and at the same time expanding the tissues.

All the measurements were made with a Beck micrometer ocular, calibrated by a Watson stage micrometer.

A " pointalite " lamp was used during the examination of the mouth-parts of the adult and the larva and also of the genitalia of the adult, since a certain amount of delicate dissection was necessary. The use of this lamp also made subsequent microscopic examination more easy.

Method.

Small glass tubes, cut off to within half an inch of the bottom, were used. Each of these tubes contained one egg. Ten eggs were reared to maturity from the thirty-two originally obtained. This mortality was in the main caused by mishaps in handling and the difficulty in adjusting the food requirements. The tubes were examined daily for cast skins and when these were found they were warmed in carbolic acid in absolute alcohol and mounted in canada balsam. In most cases all the different stages were measured with an ocular micrometer. Because of their changing form consequent on extrusion and retraction of the body folds and because it was thought better to measure the larvae alive the measurements are not accurate to a high degree, but were found to be very constant when specimens were remeasured after a short time and may, therefore, be accepted.

The problem of feeding the larvae was most difficult. If a whole grain of maize or corn is offered to a first-stage larva it bores into the grain and it is impossible to observe the succeeding stages. So too, if a quantity of synthetic whole meal flour (semolina, wheat germ and bran in about equal proportions) is given to the larva, the moulted skins are very difficult to discover, since the larva itself is only about 0·8 mm. long. The method adopted was to cut a small piece from a maize grain to feed the first-stage larva. When it had moulted and so become less capable of searching far for its food, a small quantity of synthetic whole-meal flour was added—the quantity being increased with the successive moults.

It was found that in the absence of abundant food material the life cycle of the larva was longer. It moulted more often and did not grow as large as a well-nourished specimen. If food was given sparingly to a larva in its later stages it died.

In addition to the experiments with the ten eggs that were reared from egg to adult, supplementary experiments were carried out to determine doubtful points in the morphology of the various stages such as the presence or absence of ocelli, or in the biology such as the periods between moults.

A series of fifteen additional larvae were isolated and the prepupal and pupal characteristics observed.

The Life-History of Rhizopertha dominica.

As has been explained, a complete sequence of larvae either in maize or other cereals was not made because in whole grains the insects are concealed and when disturbed cannot be induced to resume feeding. However, by correlating observations on the life-history of the larvae reared on synthetic whole-meal flour, with observations made on larvae dissected from whole grains, it is possible that an accurate account of the life-history in both these media can be arrived at.

The following is such a general account of the life-history together with descriptions of the various stages, incorporating as indicated the observations of other workers which have been verified by my own work.

The insects which supplied the complete record of the life-history lived in an incubator at 26° C. and at an approximate relative humidity of 65% between 12th October, 1931 and 12th January, 1932. These detailed observations on the life-history have also been correlated with more general or casual observations made by me on *R. dominica* as occasion offered. Work on the morphology of the insect was also carried out over an extended period in this way.

The eggs are laid, either on the grain, when they are generally laid in batches, or loose among the frass produced by the insect, when they usually occur singly. Batches of eggs are also laid attached to the tin or other vessel in which the insects may be kept.

Both larvae and adults feed on the same material, the adults probably causing as much destruction as the larvae.

Schwardt (1933) states that newly hatched larvae placed on finely divided foods, the nature of which he does not specify, did not survive. In my experiments, however, newly hatched larvae did survive on whole-meal flour although not on white flour. A favourite place for oviposition on the maize grain is at the pointed embryo end underneath the paleae. This site for the eggs may be chosen because it is the softest part of the grain and is thus the easiest point of entry for the young larva. Another reason may be the nutritional properties of the embryo itself.

The duration of the hatching period varies according to the climatic conditions and possibly with the time of year. Chittenden (1911) gives 14 days for America. Barnes and Grove (1916), in India, give 5–6 days in May and August but 7–11 days in September and October. Under incubator conditions stated above, the eggs take from 12–18 days to hatch, but, at a temperature of 30° C. this period is reduced. Schwardt (1933) gives the period in an incubator at 84–86° F. (28·8–30° C.) on yeast-foam as 18 days in September and, presumably under other conditions, as 41 days for eggs hatching in March, April to 9th May. Schwardt's statements of the incubation periods are for this reason confusing.

An active campodeiform larva hatches from the egg which burrows into the grain at any convenient point of entry as has been described.

When feeding on grain, the larva, having bored in, remains there for the rest of its life-history. During this time, according to Lesne (1924 (*b*)), it undergoes from 4–5 moults, but the life-history has never been worked out in detail in the grain.

In the experiments conducted with synthetic whole-meal flour, it was found that the usual number of moults was three, exceptionally two or four. In every instance there was a prepupal stage, which did not involve moulting, followed by a pupal stage which was succeeded by the adult.

The first-stage larva moults after about 21 days at 26° C., although the time taken varies within wide limits and it is probable that the abundance or lack of food material plays a considerable part in this. The periods recorded varied between 8 and 47 days.

The second-stage larva is less active than the first-stage and it is doubtful whether it is capable of boring into intact grain, but it still has considerable powers of locomotion. After approximately 11 days the second moult takes place, though the period of this instar may also vary widely, periods of 4 days and 29 days being recorded.

The third-stage larva seems incapable of locomotion on a flat surface. It is recurved and scarabaeiform and the head is retracted into the thorax, which is markedly enlarged. The legs, compared with the rest of the body, are smaller than those of the primary larva. It is, in fact, similar in character to the ordinary Bostrychid larva. The third moult takes place in about 10 days, although, as has been previously stated, the larva may pass straight to the prepupal stage without undergoing the third moult. It took 9 days to do this in the instance recorded.

The fourth-stage larva is similar to the preceding instar and is succeeded, as a general rule, by the prepupal stage after a period of about 10 days. An exceptional case of a fourth moult is recorded; this moult took place 5 days after the third moult and the prepupal stage was reached 10 days later. The fifth-stage larva is similar to the fourth.

The prepupa has, in general, the features of the preceding instar, but the larva has straightened out and become motionless and the head is exserted as if forced out by the pressure of the fluid in the body. The prepupal stage lasts about 1½ days, and is followed by the pupa.

The pupa is the one stage in the life-history during which it is possible to distinguish the sexes. No sexual dimorphism had so far been recorded for this species. It is a pupa libera, lying free wherever it may be. The abdomen is capable of a certain amount of movement and the tip of it is covered by the moulted skin of the prepupa. The tip of the abdomen shows the sexual dimorphism and the moulted skin must be removed before this can be seen. The differences are shown and described in the detailed description of the pupa. The pupal stage lasts about 6½ days, after which time the adult emerges. Schwardt (1933) gives an average pupal period of 6 days, but does not state the conditions specifically. He also states that the beetles fast for 3–5 days after emergence and that they feed for 15 days before laying eggs.

The total life-history from egg to adult thus averages 58 days. At 30° C. and about 30% relative humidity the life-history took from 30–40 days, between September and November.

It is stated that the beetles readily take to flight and that this is one means by which they are dispersed. In this laboratory, during the period between the beginning of June and the end of August, the beetles fly when exposed to the light in a petri dish; during the rest of the year they were never observed to fly, but it is conceivable that in warm climates the flight period might be extended and might last the year round. Breeding seems more rapid here during the summer months than during the winter, although the beetles are kept in an incubator under constant conditions of temperature and humidity.

The following is a detailed description of the various stages of the life-history.

The egg (fig. 1).

This has been described by Chittenden (1911 (*b*)), Barnes and Grove (1916) and Lesne (1924); the three descriptions vary in details. Schwardt (1933) gives the incubation periods for Kansas.

I found the eggs liable to vary in shape, even when laid singly, and that in the groups of eggs which were in the form of a raft, each individual egg was deformed by its neighbours.

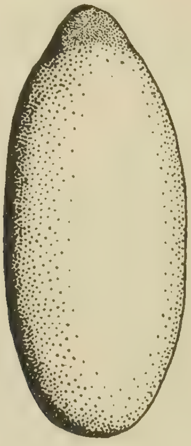

1

FIG. 1.—The egg.

The typical egg was found to be at first glistening and white, but later rosy and opaque, wrinkles appearing on the surface. It was almost cylindrical, gently rounded at one end and somewhat pointed at the pedicel end. The latter end had a brownish tinge.

Some time before the egg hatches the larva may be seen coiled up beneath the chorion. The larva eventually emerges by biting through the chorion with its mandibles and emerging from the pedicel end through a circular hole.

The average length is 0·59 mm. and the diameter 0·2 mm. This description differs in some points from those of the authors mentioned above, but the inconstancy in the shape of the egg renders description difficult.

The hatching period is 15·5 days, on the average, at 26° C. and 65% relative humidity in December. Barnes and Grove (1916), writing of conditions in India, give tables showing details of egg laying, the numbers of eggs laid by individuals, and the dates of oviposition. According to these observers, the largest number of eggs laid by a single insect was 586 and the general number is between 300 and 400. The time taken to lay this number of eggs is considerable.

According to Barnes and Grove, a female took about 6 weeks to lay 349 eggs. The female continued to live after the cessation of oviposition and another male was put in with it after 14 days. Fourteen days after this the female began to oviposit again and continued to do so for a further two months. It then ceased to lay eggs, but lived on in a quiescent condition for six months, when it died. This female laid 586 eggs in all. Barnes and Grove consider from this that one copulation is not sufficient to fertilise all the eggs. They also found that a male is capable of copulating at least twice.

The eggs are laid either singly or in batches. The batches take the form of a number of eggs adhering together in the form of a raft. A raft may number up to 30 eggs; from 2 to 5 are frequently found. When the insect is living on maize, a favourite position for oviposition is under the papery paleae of the maize grain and the newly hatched first-stage larvae may also frequently be found in this position. It is a habit of *R. dominica* to produce a large amount of frass prior to egg laying. This frass consists of food material, chewed off but not eaten. It was found that if the beetles were not paired this frass was not produced. This suggests that it is produced only as a response to fertilisation.

The primary larva (figs. 2 and 3).

The primary larva has been described by Chittenden (1911), Barnes and Grove (1916) and Lesne (1924 (*b*)). Chittenden's account, which is the fullest, is as follows: "White, slightly yellowish towards the head; head yellowish, ocelli reddish brown, arranged in a triangle. Mouth-parts brownish, antennae very short, the head beset with long hairs. Legs tolerably long, slightly yellowish with long claws. Each of the abdominal segments bears ventrally a number of long hairs, and similar hairs are also on the dorsal side of the segments 7 and 8. The last segment has a slightly curved yellow horn, directed backward. Length a little less than 0·3 mm."

This description requires amendment, in that there are usually four ocelli on either side of the head, three of the four in each instance in a triangle which is situated dorsally and a fourth which is immediately below and ventral to the triangle. The hairs of the head and thorax are considerably shorter than the long hairs on the abdomen.

The "slightly curved yellow horn" which has been described by Lesne (1924) in a footnote as a pair of little horns which represent cerci and which he observed in the primary larva of *Dinoderus* and in that of certain other Bostrychidae is, as Chittenden states, a median dorsal structure, shaped somewhat like a rose thorn, with the point directed backwards.

The primary larva is scarabeiform but not recurved (figs. 2 and 3). It is probably the only stage in the larval life-history in which the food material can be entered if it is maize, corn or similar hard material. Even at this stage it has been said, by some authors, to be incapable of piercing intact grain. That this is not so has been shown in this paper.

The head is exserted in the primary larva and becomes gradually retracted into the thorax in the succeeding stages.

There are three thoracic and ten abdominal segments. The first thoracic and the first eight abdominal segments bear spiracles. The last segment may be used as an organ of attachment to any smooth surface.

The following is a table of the chief characteristics of the primary larva :—

(*a*) A median spine, curved and directed posteriorly, is present on the median dorsal surface of the last abdominal segment.

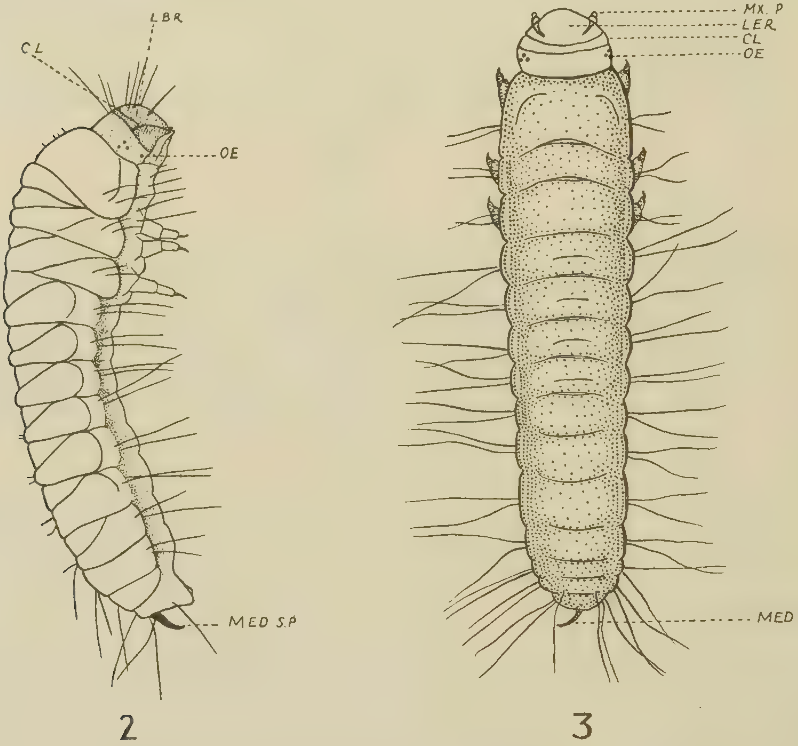
(*b*) It is scarabeiform but not in the least recurved; it is capable of active locomotion.

(*c*) Four ocelli are usually present on each side of the head. The number of ocelli is, however, very variable. Three are arranged in a triangle on either side, the fourth is somewhat ventral in position.

(*d*) The dorsal surface of the prothorax is smooth anteriorly but with slight granulations and corrugations posteriorly.

(*e*) The pro- meso- and metathorax do not differ from one another to any marked extent.

(*f*) The pleural pads of the abdominal segments are much more marked than those of the thorax.



Figs. 2–3.—The primary larva, 2, side view; 3, dorsal view; Oe. = ocellus, Med. Sp. = median spine, Ler. = labrum, Cl. = clypeus, Mx. P. = maxillary palp.

(*g*) Long hairs clothe the sides of the abdomen, those on the thorax being much shorter. The head is clothed in hairs of about the same length as those of the thorax.

(*h*) The larva often moves with a looping action, there being an anal papilla, which is apparently capable of use as a sucker.

Average Measurements.

Length.	Breadth. Head.	Breadth. Thorax.	Breadth. Abdomen.
0·783 mm.	0·132 mm.	0·198 mm.	0·172 mm.

On moulting the first-stage larva is succeeded by a second stage, somewhat similar in appearance, the characteristics of which are as follows :—

(*a*) There is no process at the posterior end.

(*b*) It is not recurved and is capable of locomotion.

(*c*) The head is but slightly retracted and the four ocelli on either side are clearly visible, as in the first-stage larva. (Exceptionally they may be reduced or absent.)

(*d*) The dorsal surface of the prothorax is granulated.

(*e*) The prothorax is not markedly different from the meso- and metathorax of the first stage, and the thorax as a whole is not sharply differentiated from the abdomen.

(*f*) When it is disturbed it does not always assume a curled up position.

(*g*) The last segment of the abdomen is horseshoe-shaped, the open part directed ventrally. The two ends of the horseshoe form slight protuberances.

Average Measurements.

Length.	Breadth. Head.	Breadth. Thorax.	Breadth. Abdomen.
1·075 mm.	0·165 mm.	0·287 mm.	0·242 mm.

The third-stage larva differs markedly from the two preceding stages. It has all the characteristics of the mature larva, which is described in detail later on.

The characteristics of the third-stage larva are as follows :—

(*a*) The head is retracted so that the ocelli are not as a rule exposed, although they are present, if present in the two former instars. The ocelli are always less marked and are breaking down.

(*b*) The body is normally recurved, although it may straighten out. It is incapable of locomotion on a flat surface.

(*c*) The thorax is somewhat larger in circumference than the abdomen. The prothorax is markedly enlarged, and its dorsal surface area is equal to that of the meso- and metathorax together. The meso- and metathorax are each about the same width as the immediately succeeding abdominal segments.

(*d*) In its natural recurved state it has very distinct lateral folds (hypopleural folds). The body is not cylindrical as in the previous instar, but the ventral surface is flattened. The dorsal surface of segments seven and eight is enlarged.

(*e*) The end of the abdomen shows a well-marked anal furrow.

Average Measurements.

Length.	Breadth. Head.	Breadth. Thorax.	Breadth. Abdomen.
2·037 mm.	0·264 mm.	0·635 mm.	0·512 mm.

The fourth-stage larva is similar to that of the preceding stage, except that it is larger and that all the characters are slightly more emphasised.

The following are the characteristics of the fourth-stage larva :—

(*a*) The head is retracted. The ocelli are present, if they were present in previous instars, but they are reduced and retracted within the anterior edge of the prothorax.

(*b*) The body is recurved and covered with short hairs regularly arranged. The abdominal segments 5, 6, 7 and 8 are much extended.

Average Measurements.

Length.	Breadth. Head.	Breadth. Thorax.	Breadth. Abdomen.
3·069 mm.	0·413 mm.	0·859 mm.	0·776 mm.

The fifth-stage larva, when present, is similar to the previous instar. In the one instance recorded the specimen was undersized, due to lack of nourishment. It is thought that this lack was responsible for the abnormal number of moults. Apart from its smaller size, it resembled the third- and fourth-stage larvae as previously described.

The prepupa.

In this stage the insect straightens out and becomes quiescent. The head is exserted and the anterior part of the prothorax is smoother than that of previous instars. The ocelli are lost.

The legs seem more or less incapable of movement and the insect is only capable of a limited " wriggling."

Average Measurements.

Length.	Breadth. Head.	Breadth. Thorax.	Breadth. Abdomen.
3·151 mm.	0·495 mm.	0·845 mm.	0·962 mm.

The pupa (fig. 4).

The pupa has been shortly described by Barnes and Grove as follows :—" At first quite white, later brown pigment is laid down in the eyes and trophi. The pupa exhibits the characteristic depressed head and enlarged thorax of the adult. The dorsal surface is covered with hairs."

The pupa is a pupa libera, lying free wherever it may happen to pupate. There are seven visible terga and an appendage (the external genitalia) at the end of the abdomen, which is mobile.

The chief characteristic of the pupa, which has not previously been recorded, is that sexual dimorphism is manifested at the posterior end of the abdomen. This is of some importance, since at no other stage in the life-history is it possible to distinguish the sexes.

The end of the abdomen of the female (fig. 4) possesses two three-segmented papillae projecting from it.

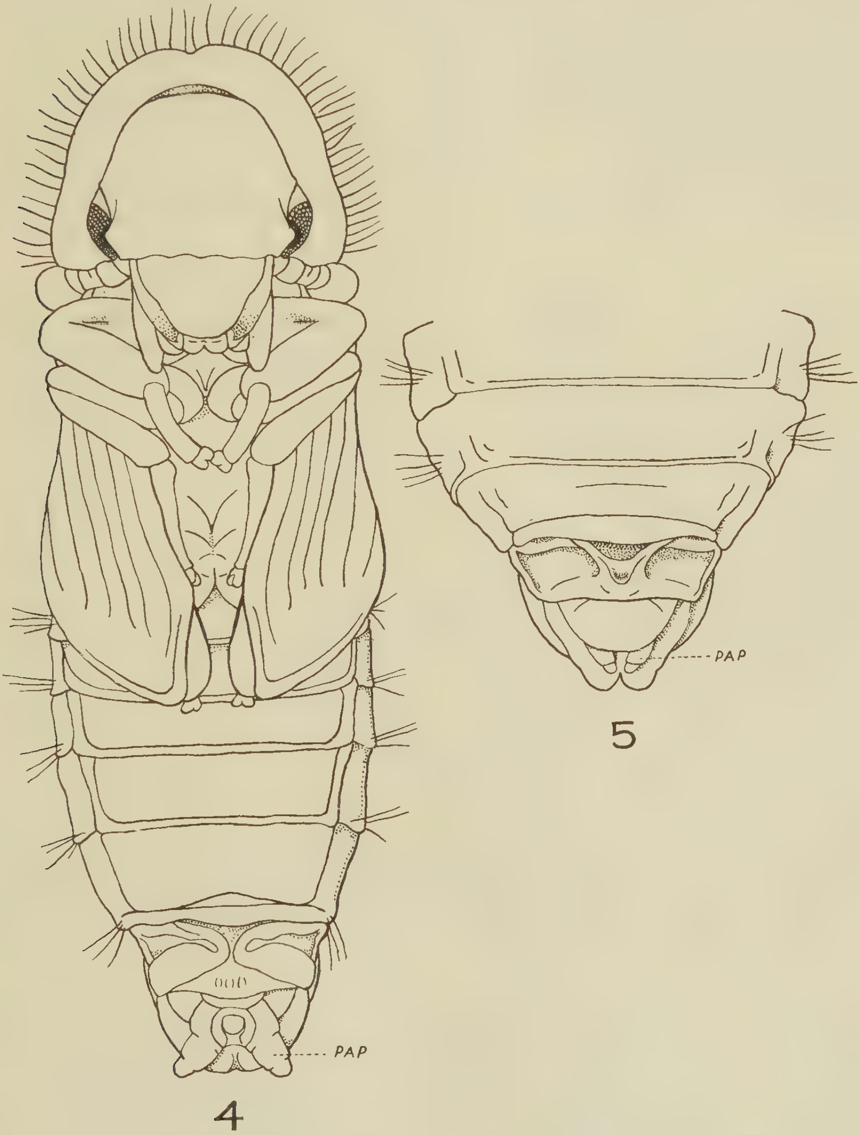
In the male (fig. 5) there is a pair of two-segmented structures fused to the abdomen for their whole length. The apices of the abdomen differ in other details, as may be seen from the two diagrams. The last larval skin generally remains attached to the end of the abdomen and must be carefully removed to allow the pupal characteristics recorded above to be seen.

Average Measurements of the Pupa.

Length.	Breadth. Head (across the eyes).	Breadth. Thorax (elytra).	Breadth. Abdomen.
3·914 mm.	0·627 mm.	0·905 mm.	1·106 mm.

The mature larva (fig. 6).

The mature larva has been recorded and described by Chittenden (1911), Lesne (1924 (*b*)) and Gardner (1933). Lesne gave the first technical description of the larva, but Gardner's description is more detailed.

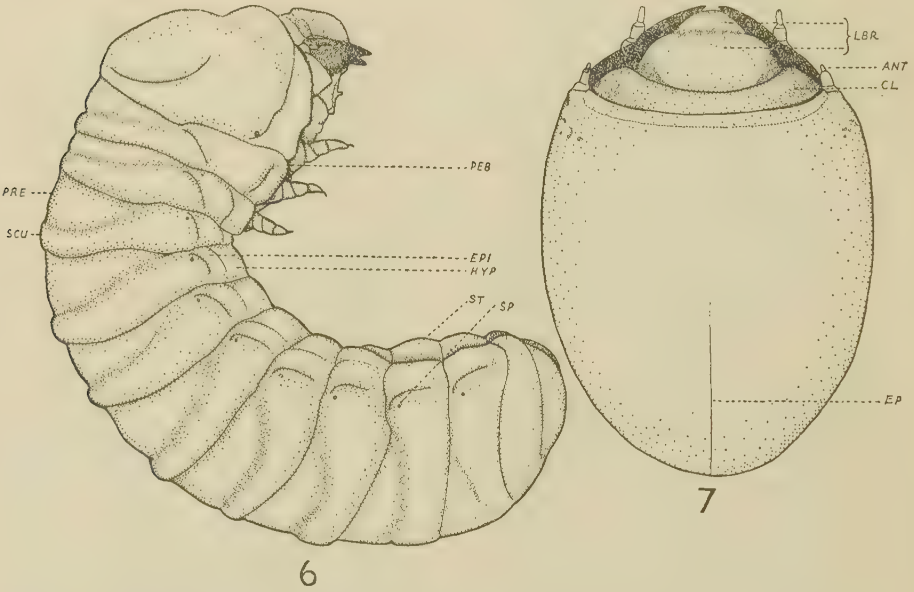


Figs. 4–5.—4, The female pupa; Pap. = three jointed papilla; 5, the male pupa; Pap. = two jointed structure.

A full description of the larva, together with the diagrams reproduced here, was made before the publication of Gardner's paper. My results agree with those of Gardner, but the description given is somewhat fuller, since he wrote mainly with a view to the systematic relationships of the larva. In addition to the other structures, I found it advisable to adopt a terminology for the folds of the body-wall and, for this purpose, the terminology of Hopkins (1909), as adapted by Munro (1915) for Anobiid larvae, is used.

The mature larva (fig. 6) is about 2·8 mm. long; it is covered with hairs (which have been omitted from the diagram for the sake of clarity). The hairiness is especially marked on the hypopleural folds, the feet, the scutellar fold, the dorsal region of the abdominal segments 6–9 and the anal region.

The head is ellipsoidal (fig. 7). It is retracted into the thorax, so that it only projects as far as the clypeus and the base of the antennae. A trace of an epicranial suture is present on the dorsal surface, but no frontal sutures are discernible. These sutures are well marked in the first-stage larva. The head capsule is thus not differentiated into sclerites, but the anterior edges of the dorsal, ventral and lateral aspects of the capsule have areas of thickened chitin.



Figs. 6–7.—6, The mature larva; Pre. = prescutal fold, Scu. = scutellar fold, Epi. = epipleural fold, Hyp. = hypopleural fold, St. = sternal fold, Peb. = pedal fold, Sp. = spiracle; 7, The head of the mature larva; Ep. = epicranial suture, Ant. = antenna, Cl. = clypeus, Lbr. = labrum.

These areas are collectively termed the Epistoma dorsally, and Hypostoma and Pleurostoma ventro-laterally (Böving 1922). The ventral surface of the capsule is flattened. The antennae are inserted at the sides of the head on papillae arising from the head capsule. The clypeus is a broad sclerite slightly emarginate in front for the reception of the labrum. The posterior edge of the clypeus is situated under the dorsal surface of the head capsule, the anterior edge of which is invaginated. The labrum is a large oval structure inclined at an angle of about 45° to the plane of the clypeus and the long axis of the head. The labrum is convex posteriorly, but flattens out anteriorly. The ventral surface of the head is occupied by the labium and the maxillae and the occipital foramen. The mentum and submentum of the labium are not especially chitinised and can only be seen when looked for on the ventral surface of a fresh specimen.

The following is a detailed description of the appendages of the head.

The antenna (fig. 8) consists of two segments set on a button. (Lesne (1924 (*b*)) describes the Bostrychid larva in general as having three antennary segments, the first being very small. I was unable to detect this small first segment in the larva of *R. dominica.* Gardner (1933) also considers that there are only two segments. The first segment carries a short conical papilla at its apex, set just below the insertion of the second segment. According to Lesne this papilla, which is present in many families of coleoptera, is a general character of Bostrychid larvae and may offer diagnostic features. Lesne refers to this papilla as the " Hyaline papilla " or " Appendix." In addition to this papilla there are four long hairs at the apex of the first segment. The second segment carries a few bristles at its apex. The first segment is longer than broad. The second segment is smaller, about half as broad as the first segment and about twice as long as broad.

The mandible (fig. 9) has three teeth on its inner edge, the distal tooth being most strongly developed. The mandible bears at its base a molar area which projects internally and dorsally to work in conjunction with a semicircular sclerome on the epipharynx. There is a tuft of hairs towards the distal end of the molar area, and on the border nearest the base of the mandible a membranous lobe or " lacinia mandibulae " is present.

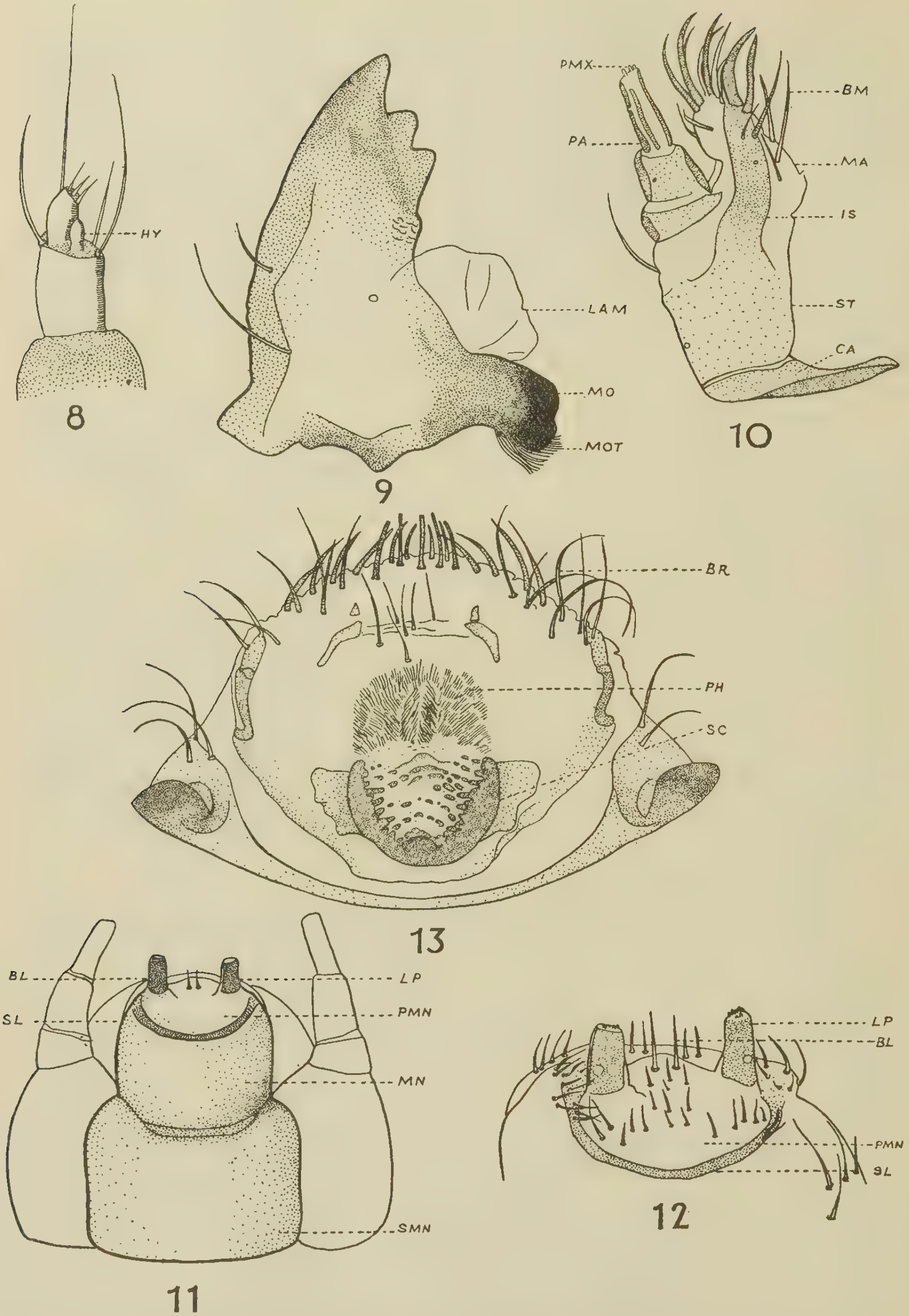
The maxilla (fig. 10) consists of a cardo and stipes bearing a three-segmented palp and maxillary lobe or mala. The bristles of the maxillary lobe are thick and divergent and concentrated over the apical area. A thickened internal strut of chitin runs from half-way down the internal border of the maxillary lobe diagonally towards a similarly thickened area on the external border of the cardo. Gardner (1933) regards the spine arising from the apex of this diagonal strut as representing the lacinia. Böving (1922) considered that the diagonal strut divided the maxillary lobe into galea and lacinia. The first segment of the maxillary palp is small and triangular in shape and is regarded by Gardner (1933) as a palpifer. The second is larger and about as long as it is broad. The third is longer than the second, but narrower; it is about $2\frac{1}{4}$ times as long as broad and bears three small papillae on its apex.

The labium (figs. 11 and 12) consists of a submentum and mentum bearing the labial palps, which are of one segment, and are situated at the apices of a semicircular chitinous band, termed the " stipes labii " by Böving (1922). The stipes labii is fringed with small stout bristles towards either extremity. The area anterior to the stipes labii may be called the prementum. There is no projecting ligula between the palps, but the area enclosed by the stipes labii is sparsely covered with bristles of medium length. There are two large bristles in between the labial palps.

The maxillulae (superlinguae) consist of two closely adjoining tufts of short hairs on the hypopharynx or floor of the mouth, situated posteriorly to the labium.

The labrum-epipharynx (fig. 13) is approximately oval in shape and bears a row of stout bristles on its free border. The epipharynx bears a large semicircular sclerome, the concave surface of which is rugose. The molar areas of the mandibles probably work against this sclerome. Immediately anterior to the sclerome are two patches of hairs which almost meet along the median line.

Before describing the abdomen and thorax, some mention should be made of the nomenclature of the folds of the body-wall. As has been stated above, the nomenclature I have adopted is that of Hopkins (1909) as revised by Munro (1915). A typical segment of the larva of *R. dominica* possesses on the dorsal


HY
8
LAM
MO
MOT
9
PMX
PA
BM
MA
IS
ST
CA
10
BR
PH
SC
13
BL
SL
LP
PMN
MN
SMN
11
LP
BL
PMN
SL
12

Figs. 8–13.—8, The antenna of the mature larva; Hy. = hyaline papilla; 9, The mandible of the mature larva; Mo. = molar, Mot. = molar tuft, Lam. = lacinia mandibula; 10, The maxilla of the mature larva; Ca. = cardo, St. = stipes, Pa. = palp, Ma. = mala, Bm. = bristles of mala, Is. = thickened internal strut, Pmx. = papillae of maxillary palp; 11, The labium of the mature larva; Smn. = submentum, Mn. = mentum, Lp. = labial palp, Sl. = stipes labii, Pmn. = prementum, Bl. = bristles of the ligula; 12, The anterior portion of the labium of the mature larva; Pmn. = prementum, Sl. = stipes labii, Bl. = bristles of the ligula, Lp. = labial palp.; 13, The labrum-epipharynx of the mature larva; Br. = bristles, Sc. = sclerome, Ph. = patches of hair.

surface an anterior prescutal fold and a posterior scutellar fold; and on the lateral surface an epipleural fold on each side. Ventrally there is a sternal fold which may be subdivided, but the subdivisions have not been studied, since they do not appear to be important systematically and would add considerably to the complication of the nomenclature.

The thorax (fig. 6) consists of well-marked pro- meso- and metathoracic segments, each segment bearing a pair of legs. The thorax as a whole is slightly larger in circumference than any of the succeeding abdominal segments.

The prothorax has a much enlarged dorsal surface, the scutellar fold taking on a hood-like form, while the prescutal fold is absent. The epipleural folds are well marked, but narrow and elongated. Small pedal folds are present but are obscured by the epipleural folds. A small sternal surface is present. A spiracle is present at the base of the scutellar fold of the prothorax on the posterior margin.

The mesothorax has the dorsal surface divided into prescutal and scutellar folds. The epipleural folds are broad. There are small pedal folds and a small sternal fold.

The metathorax is similar in constitution to the mesothorax except that the epipleural folds are reduced.

The legs are approximately equal in size and development. Each has a single curved brown claw. The leg consists of three segments, not counting the prominence by which it is connected to the body and which may be termed the coxa, or the minute joint or tarsus which serves as an articulation for the claw. The three segments may be termed the trochanter, femur and tibia. The hairs on the leg are similar to those on the body, except for some short stiff pointed bristles inserted on the internal border of the tibia.

The abdomen (fig. 6). Each of the first eight abdominal segments is divided dorsally into a prescutal fold and a scutellar fold, which are separated by the two epipleural folds from the sternum, which is itself indistinctly subdivided into folds. In some positions of the larva, traces of the division into epipleural and hypopleural folds may be discerned. The division takes the form of light indentations in the epipleural folds. The ninth segment has reduced epipleural folds and the tenth segment has none. The dorsal surface of the ninth and tenth segments is not distinctly divided into prescutal and scutellar folds. Segments seven and eight are enlarged, nine is reduced and ten is still further reduced. The anus opens on the tenth segment at the base of a furrow which runs dorso-ventrally. This furrow is formed by two prominences of the tenth segment and is referred to in the literature on the subject as the " anal fold."

The spiracles (fig. 6). There is a spiracle on the prothorax and on each of the first eight abdominal segments. The spiracles are situated just above the epipleural folds; the eight abdominal spiracles are equal in size and are slightly smaller than the thoracic spiracle, all are circular.

Systematic Position.

Lesne (1924) gave a key for separating the full-grown larvae of the Dinoderitae, the Lyctitae and the Bostrychitae, which are three of the subfamilies of the family Bostrychidae. Lesne includes *R. dominica* in the subfamily Dinoderitae.

Böving and Craighead (1931) in their key to the larval forms of the Coleoptera, separate the larvae of the family series Bostrychoidea into the families Ptinidae, Anobiidae, Bostrychidae, Lyctidae and Psoidae and they place the genus

Rhizopertha in the last family. The family PSOIDAE of Böving and Craighead includes the same genera as the subfamily DINODERITAE of Lesne, except that the PSOIDAE includes the genera *Polycaon* and *Psoa* which are not included in the DINODERITAE, and the DINODERITAE includes the genus *Prostephanus* which is not included in the PSOIDAE. The PSOIDAE includes the following genera :—*Stephanopachys*, *Rhizopertha*, *Dinoderus*, *Dinoderopsis*, *Polycaon* and *Psoa*. According to Böving and Craighead the larvae of the BOSTRYCHIDAE, PSOIDAE and LYCTIDAE may be distinguished from the PTINIDAE and ANOBIIDAE by the fact that the former have the head retracted and have no asperities on the terga.

The characters given in the key of Rymer Roberts (1930) do not appear to be satisfactory in this instance.

Gardner (1933) gives an excellent key to the Bostrychid larvae. He used the work both of Lesne and of Böving and Craighead, but he returns to Lesne's classification, although he corrects Lesne's subfamily terminations, using " inae " instead of " itae." Lesne uses " inae " to denote a tribe of a subfamily.

Those parts of Gardner's key which are necessary for the identification of the larva of *R. dominica* are given below.

" The chief characters of the mature larva of the family BOSTRYCHIDAE are as follows :—Head longer than wide and deeply retracted into the thorax. Antennae usually prominent though small, with three segments and a basal connecting skin. (*R. dominica* is an exception to this rule, the antenna possessing only two segments.) Mandibles usually gouge-shaped distally. (*Rhizopertha* is again an exception.) Labrum movable. Maxillae reinforced on the inner margin by a brownish thickening and with or without a freely projecting maxillary stylet. Labium with a prementum limited posteriorly by a transverse brown line (stipes labii). Submentum and prothoracic skin continuous. Legs usually well developed. Body curved, enlarged at thorax. Spiracles annular. Tenth abdominal segment in front of anus has a pair of adjacent lobes separated by a longitudinal groove. Urogomphi (cerci) absent."

The subfamily DINODERINAE, in which *Rhizopertha* is included, may be distinguished from the other subfamilies of the BOSTRYCHIDAE by the following characters :—

Mandible with a pseudomolar process (mola) extending to a sclerome on the epipharynx. The mandible possesses in addition a large fleshy appendage (lacinia mandibulae). Prothorax without lateral rod-like thickenings. (Distinction from BOSTRYCHINAE.)

Last abdominal spiracle small and not larger than that on the thorax. (Distinction from LYCTINAE.)

The labial palp with one segment. Maxillary palp with two segments borne on a palpifer (or three segments). (Distinction from PSOINAE and APOLEONINAE.)

The DINODERINAE contains two genera, viz. *Dinoderus* and *Rhizopertha*. The genus *Rhizopertha* contains one species *R. dominica*.

The characters distinguishing *R. dominica* from the genus *Dinoderus* are :—

(*a*) In *Rhizopertha* the mandible is tridentate, in *Dinoderus* there is only one well-marked tooth.

(*b*) The antenna of *Rhizopertha* consists of two segments, that of *Dinoderus* has three distinct segments.

(*c*) The body is only lightly curved normally and there is no very marked enlargement of the thorax in *Rhizopertha*; the genus *Dinoderus* has the body strongly curved and the thorax is markedly enlarged in relation to the abdomen.

The Adult.

There are several descriptions and figures of the adult *R. dominica* in the literature. Lesne (1924 (*b*)) gave a systematic but not a detailed one. He did not give any description of the mouth-parts, wing-venation, or genitalia.

The insect (fig. 14) is cylindrical, ranging from about 2·3 mm. to 2·8 mm. in length and is of a dark reddish-brown colour. The head is retracted into the prothorax, which is hood-like; the aperture in the prothorax to receive the head opens towards the ventral surface. The elytra and prothorax are covered by hairs which are strongly curved.

The head.

As already stated, this is retracted into the prothorax, but when extracted is globular in shape. The dorsal region of the vertex has a ridge for the attachment of muscles, called the external sagittal apodeme by Lesne (1924 (*b*)). The vertex is smooth and glistening, the epistome finely punctured. There is no epicranial suture and there are no frontal sutures. The ventral surface shows a triangular gular plate, the gular sutures uniting and passing as a single suture to the edge of the occipital foramen. The epistome is in the form of a narrow depression, without sutures and is situated between the eyes. This is followed by a broad clypeus. The clypeus and epistome are covered by hairs, which are bent down over the surface. The clypeus is transverse. The labrum is approximately rectangular, but widens out at its fixed edge. The surface is covered with hairs in the same manner as the clypeus, but in addition, the anterior edge is thickly fringed with long hairs. This fringe extends laterally half-way down the free border, but the lateral fringe is less dense than that on the anterior edge. The labrum is at an angle of about 45° to the plane of the clypeus.

The eyes are situated at the sides of the head.

The antennae are inserted laterally at the internal angle of the eye, between the eye and the base of the mandible, at the anterior edge of the epicranium.

The antennae (fig. 15).

The antenna consists of ten segments, the first two subequal in size and larger than the next five, which are subequal in length but get broader distally. The last three segments form a loose club, the first two segments of which are triangular in shape and the apical segment is oval. The three segments of the club are covered with short setae; the other segments have a few setae on each.

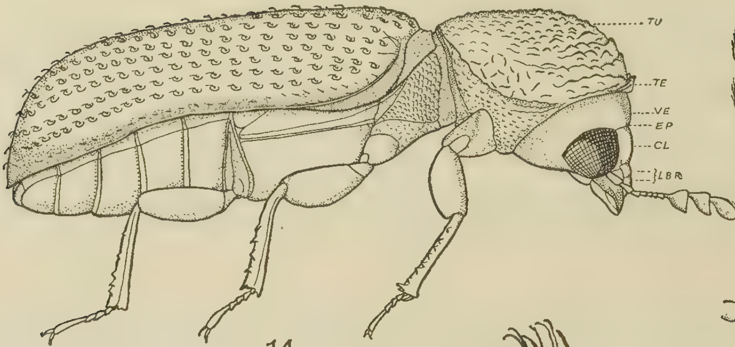
The mandibles (fig. 16).

The mandibles are toothed on their anterior internal border; there are a few bristles on the external surface.

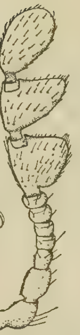
Each of the mandibles has a large molar area, which bears a tuft of hairs; a lacinia mandibulae is also present. The mandible of the adult thus resembles that of the mature larva in its most salient features.

The maxillae (fig. 17).

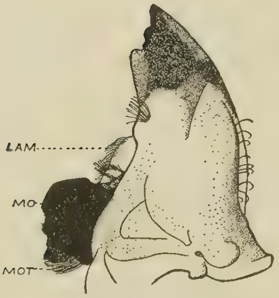
These consist of a cardo and stipes bearing a four-segmented palp, galea and lacinia. The galea is divided into two distinctly chitinised areas; a small basal area or subgalea and a larger apical area. The setae of the maxillae can be divided into three types (1) small hairs, (2) larger bristles, (3) stout spines. The apex of the galea has three or four stout spines and a large tuft of bristles. The lacinia has four or five pairs of stout spines on its internal border, from the apex to about one-third of the way down the border. There is also a series of bristles on this border and a few hairs covering the surface of the lacinia.


TU
TE
VE
EP
CL
LBR

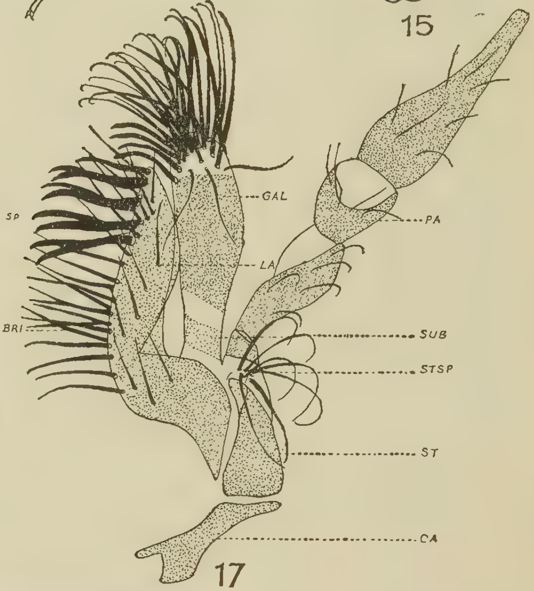
14



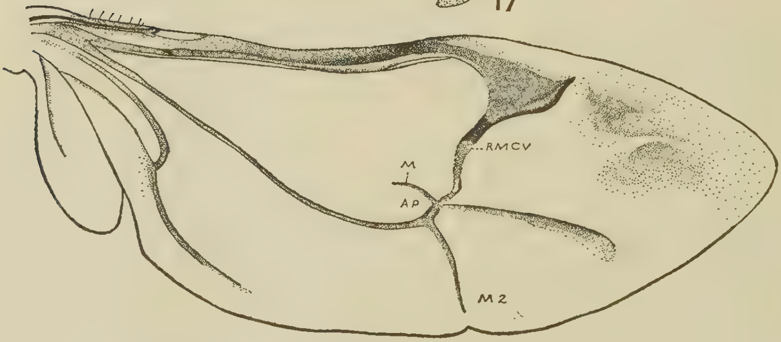
15



16


SP
GAL
LA
PA
BRI
SUB
STSP
ST
CA

17



20

Figs. 14–17, and 20.—14, The adult; Ve. = vertex, Ep. = epistome, Cl. = clypeus, Lbr. = labrum, Te. = teeth of the prothorax, Tu. = tubercles of the prothorax; 15, The antenna of the adult; 16, The mandible of the adult; Mo. = molar, Mot. = molar tuft, Lam. = lacinia mandibula; 17, The maxilla of the adult; Ca. = cardo, St. = stipes, Pa. = palp, Gal. = galea, La. = lacinia, Sub. = subgalea, Sp. = spines of the lacinia, Bri. = bristles of lacinia, Stsp. = spines of the stipes; 20, The wing; Ap. = apertum, R.M.C.V. = radio-median cross-vein, M. = recurrent median (M. 1.), M2 = 2nd branch of the median.

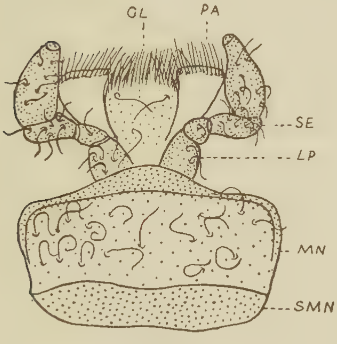
The first segment of the palp is very small; the second is much larger and is about twice the length of the third, although not quite so broad. The fourth segment is the largest, being about three times the length of the third segment and characteristically spindle-shaped. The surface of the palp is covered with a few scattered hairs. Between the base of the first segment and the apex of the stipes is a tuft of spines.

The labium (fig. 18).

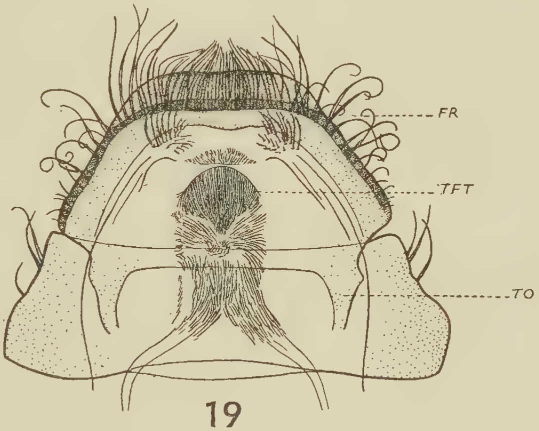
This consists of a very short submentum, followed by a large mentum, bearing the four-segmented palps, glossa and paraglossae.

The glossa is spatula shaped and has a thick fringe of long setae. The paraglossae take the form of transparent triangular wings on either side of the glossa. They are difficult to see, but may be recognised by the fringe of long setae, which is attached to their anterior free border. The glossa, paraglossae and palps are connected loosely by membrane to the thickly chitinised mentum, the anterior edge of which is thickened.

The first segment of the palp is broad and partly obscured by the mentum; the second is about half as broad and is about as long as it is broad. The third segment is about as long as the second, but broadens out anteriorly. There is a thick fringe of setae forming a ring round the anterior portion of this segment. The fourth segment is the largest, over twice as long as the third segment and spindle-shaped. It bears a few papillae on its apex. The surface of the mentum and palps bears a few setae.



18



19

Figs. 18–19.—18, The labium of the adult; Smn. = submentum, Mn. = mentum, Lp. = palp, Gl. = glossa, Pa. = paraglossa, Se. = ring of setae; 19, The labrum-epipharynx of the adult; Fr. = fringe of hairs, Tft. = patch of hairs, To. = torma.

The maxillulae.

The maxillulae are similar in character and position to those found in the mature larvae. They take the form of two tufts of hairs, situated inside the buccal cavity on the hypopharynx, just above the labium and attached to it by membrane.

The labrum epipharynx (fig. 19).

The labrum is turned in anteriorly and at its junction with the epipharynx a fringe of long hairs arises. This fringe is continued laterally, but since the labrum is not bent in laterally the fringe is continued along its edge.

There is a large patch of hairs situated in the centre of the concave surface of the epipharynx. There are two tormae at the sides of the labrum at its proximal border situated on the pharyngeal surface and projecting posteriorly underneath the clypeus.

The thorax.

The prothorax is most highly developed. It has the characteristic hood-like structure of the BOSTRYCHIDAE, the opening for the head being directed ventrally and fringed with short hairs. The prothorax is practically as long as broad, its maximum breadth being at the posterior angles. The anterior, lateral and dorsal surfaces of the prothorax are covered with blunt teeth directed backwards, with tubercles and sparsely with hairs. The teeth are arranged in a concentric manner on the anterior part of the prothorax; the first row, 12 to 14 in number, forming a crest. They become progressively smaller laterally and the lateral and posterior parts of the prothorax are tuberculate. There are no sutures on the prothorax, although Lesne states that there is a lateral suture present posteriorly. The ventral surface is hollowed out for the reception of the coxae of the first pair of legs. The posterior edge of the prothorax is fringed with long hairs. There are no furrows or foveoles. The prothorax is sparsely covered with hairs.

The mesothorax is reduced and carries the elytra. The scutellum of the mesothorax is approximately square.

The metathorax is well developed and bears the functional wings.

The legs.

These consist of coxa, trochanter, femur, tibia, and a five-segmented tarsus.

The posterior coxae are transverse; they approximate in the mid-ventral line and extend right to the lateral edge of the body. The middle coxae are globular and approximate in the mid-ventral line, but only extend half-way to the lateral margin. The anterior coxae are transverse and approximate in the mid-ventral line. They do not extend to the edge of the prothorax.

The tibiae are fringed with teeth on the external border. The anterior tibiae possess a large spur on the internal apical edge and the middle and hind tibiae have a number of smaller teeth on the apical edge.

The first segment of the tarsus is very much reduced, almost hidden by the tibia; the next three gradually increase in size. The fifth segment is as long as or longer than the preceding four together and bears two claws.

The wing-venation (fig. 20).

A figure of the wing is given by Lesne (1897), where he compares the venation with that of *Dinoderus minutus* and *Stephanopachys quadricollis*. He does not attempt to name the veins in his paper. The wing is also figured by Kempers (1923), in which paper no explanation is given to the figure.

The wing of *R. dominica* is that of a typical Bostrychid, in that it possesses a reduced Cantharid venation with a well-marked apertum. There is no radial cell or recurrent radial vein, the radio-median cross-vein running straight into the median. Lesne (1924 (*b*)) gives a further discussion of the wing-venation of the BOSTRYCHIDAE.

It is not proposed to compare the wing-venation of *R. dominica* with that of other Bostrychids here, since the systematic value of the wing-venation is doubtful in the Coleoptera. The care with which wing-venation in this order must be used for purposes of classification is exemplified by the fact that I found the venation of *R. dominica* to be exactly similar to that of *Lyctus brunneus*. The only difference in the wings, apart from that of size, is in the shape of the slightly more heavily chitinised areas.

The elytra.

The elytra are about 2¼ times as long as the prothorax. They are covered with pits, which are regularly arranged in rows to form striae. From the base of each pit arises a hair, which is bent at right angles at its mid point. On the apical declivity of the elytra, these striae become confused and the hairs are more dense. The elytra have no ridges at the suture, except on the apical declivity where there is a slight ridge. There are no protuberances on the apical declivity of the elytra. I am unable to confirm Lesne's statement that the apical border of the elytron is toothed.

The abdomen.

There are five visible sterna and an eversible segment. The first visible sternum is morphologically the third, the first two being reduced and only visible internally; it has a median projection forwards between the posterior coxae. This projection is shaped like a spearhead and rests in a hollow on the posterior edge of the metasternum. There are eight visible terga counting that of the eversible eighth segment. The first tergum is divided in the centre and is followed by two lateral vestiges of chitinisation in the membrane. The posterior edges of the eversible eighth segment are fringed with hairs. The fifth visible sternum is not emarginate for the reception of the eversible segment.

The genitalia.

Since the genitalia of insects are becoming increasingly important in connection with taxonomy and since no description of the genitalia of *R. dominica* has been published, a detailed study of these structures in both sexes was made.

The male genitalia (figs. 21, 22 and 23). The nomenclature and remarks on the parts forming the male genitalia of *R. dominica* are based on the paper by Sharp and Muir (1912) and on the observations of Lesne (1924 (*b*) : 19 and 20).

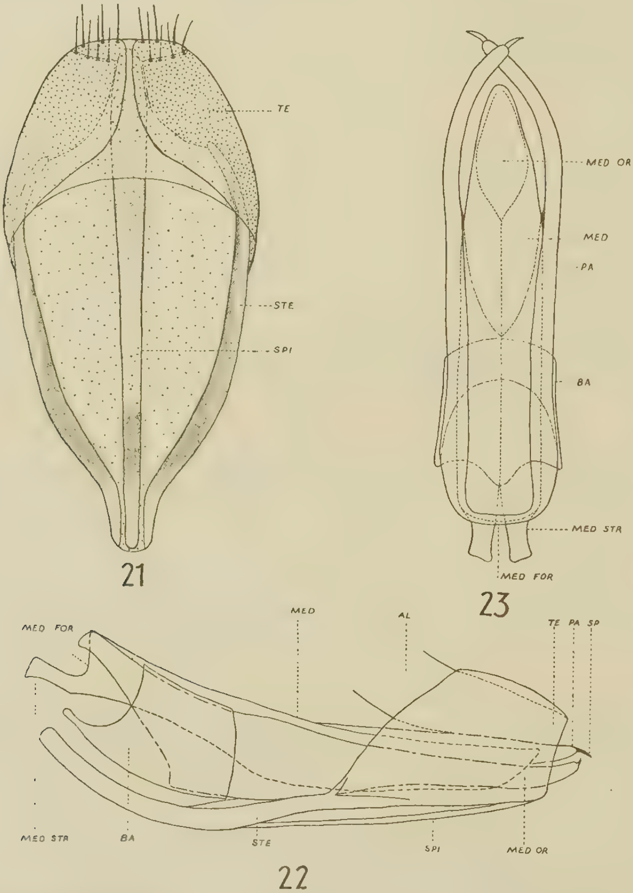
The eighth segment is partly retractile and within it lies the ninth segment and the male genitalia. The ninth segment (figs. 21 and 22) consists of a sternum composed of two struts connected by membrane, and a tergite formed of two slightly chitinised sclerites continuous ventrally with the struts of the sternum and joined dorsally by a membrane. The two struts of the sternum come together anteriorly forming a **V**. The anus opens just ventral to the ninth tergite. In the membrane of the sternite is a chitinous rod, called by Sharp and Muir the " spiculum gastrale." The genitalia consist of an aedeagus which is composed of a median lobe or penis enclosed in the tegmen, which latter consists of a basal plate and two parameres.

The median lobe (figs. 22 and 23) is a flattened tubular structure with an opening at its posterior end on the ventral side, the median orifice, through which is extruded the internal sac. Anteriorly there is an opening for the passage of the ejaculatory duct, the median foramen. Also anteriorly the median lobe bears two projecting rods of chitin, the median struts.

The parameres (figs. 22 and 23) consist of two lobes, one on either side of the median lobe. Anteriorly the parameres are fused above and below, forming a ring round the median lobe. Posteriorly, each paramere is terminated by a spine; these spines are present in other species of Bostrychidae, *e.g. Apate terebrans*, and, according to Sharp and Muir (*loc. cit.*), in this latter insect they act as guides to the median lobe when it is evaginated.

The basal plate (figs. 22 and 23) consists of a median sclerite moulded over the ventral surface of the fusion of the parameres and extending up laterally. It is rectangular in shape with a median anterior projection.

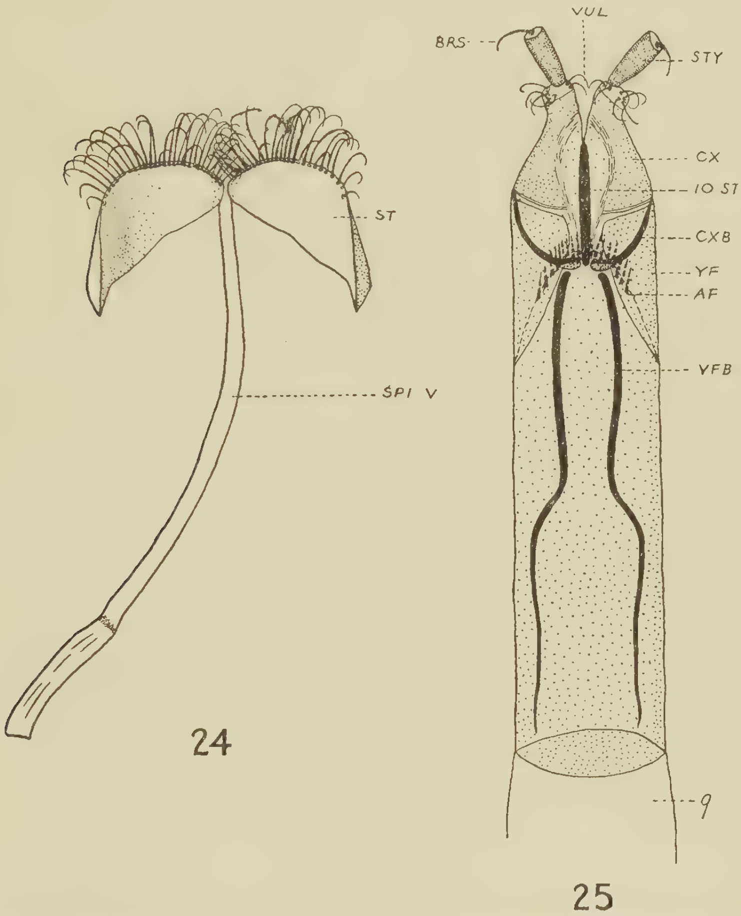
The length of the aedeagus with the median lobe retracted is about 0·04 mm. from the anterior tip of the median struts to the posterior tip of the spines on the parameres. The general conformation of the male genitalia of *R. dominica* is similar to that of *Apate terebrans*, the species studied by Sharp and Muir (*loc. cit.*). These two authors place the Bostrychidae in the Cucujoid group on the affinities of the genitalia.



Figs. 21–23.—The male genitalia. 21, ninth segment of male with the genitalia removed; 22, side view of ninth segment of male with the genitalia in place; 23, dorsal view of male genitalia; Ste. = sternal strut of ninth segment, Te. = tergal sclerite of ninth segment, Spi. = spiculum gastrale, Med. = median lobe (penis), Ba. = basal plate, Pa. = paramere, Med. Or. = median orifice, Med. For. = median foramen, Med. Str. = median strut, Sp. = spine of paramere, Al. = alimentary canal.

The female genitalia (figs. 24 and 25). The female genitalia of Coleoptera have not been extensively studied and there is, as yet, no general agreement on the homologies of the various structures forming the genital tube.

Tanner (1927) has published a survey of the female genitalia of Coleoptera in which he discusses the varying views on the subject of the homologies of the female genitalia and finally adopts those of Crampton (1919 and 1925) and Wheeler (1893). In his paper Tanner gives a standard nomenclature for the parts comprising the genitalia throughout the order Coleoptera and makes a tentative grouping of the order according to the affinities of these parts. Since Lesne (1924 (*b*)) makes but a passing allusion to the female genitalia of Bostrychids, Tanner's paper is used here as a basis for description and discussion.



Figs. 24–25.—The female genitalia. 24, eighth sternum and apodeme in the female; 25, ninth segment and genitalia of the female; St. = sternal sclerite, Spi. V. = spiculum ventrale, 9 = membranous ninth segment, Sty. = stylus, Brs. = bristle of stylus, Cx. = coxite, Vul. = vulva, 10 St. = tenth sternite, Vfb. = valvifer baculi, Vf. = valvifer, Cxb. = coxite baculi, Af. = anal flap.

In the Coleoptera the appendages of the eighth and tenth segments disappear. The ninth segment with its appendages, together with the eighth and the remains of the tenth segment, form the genital tube.

The eighth segment in the female of *R. dominica* is retractile as in the male, but the sternum in the female (fig. 24) is divided into two sclerites joined by a membrane in the mid-ventral line. From this membrane a chitinous apodeme, with a spatula-like free end, extends into the abdomen for a distance equal to the length of the last $3\frac{1}{2}$ sternites, not counting the eighth, when this latter is fully retracted. The actual length of this apodeme varies, but it is approximately 0·91 mm.; according to Lesne (*loc. cit.*) it has received the name of " spiculum ventrale " from Verhoeff.

Continuous with the eighth segment is a thin membranous tube which is reflected back into the abdomen when the genital tube is retracted, forming a sheath for the thicker more chitinous part of the tube. This thin membrane probably represents the ninth segment; it is represented in fig. 25 as if the tube were fully protruded. The more strongly chitinised part of the tube following on the ninth segment (fig. 25), bears at its posterior end two palpiform structures, the styli, each bearing a bristle. Each stylus is borne on the apex of a fork formed by the two coxites; at the base of this fork is the genital opening or vulva and in the floor of the tube at this point is a short median strut, the tenth sternite. Two pairs of apodemes are present in the anterior part of the tube and these are termed by Tanner (1927) the " baculi " and by Lesne (1924 (*b*)) the " Ventral radii," since they lie mainly on the ventral surface. The longer pair of baculi are the valvifer baculi. They abut posteriorly on to two triangular sclerites, which are only to be seen in the fresh specimen. These sclerites probably represent the vestiges of the valvifers or posterior parts of secondarily divided coxites. The shorter pair of baculi are coxite baculi and they abut posteriorly on to two sclerites representing the coxites. The two pairs of baculi articulate with each other and serve as a framework for the tube.

On the dorsal surface of the genital tube, just above the points of articulation of the baculi, is a flap fringed with bristles, which covers the anal opening. In the insects examined this flap was not visible, without dissection, either in fresh specimens or after treatment with potash. It was eventually discovered by dissecting out the rectum in a fresh specimen, finding where this terminated, and then pushing down the flap.

The female genitalia of *R. dominica* resemble in general features the Bostrychid form (*Polycaon stouti*) studied by Tanner (1927), the main differences being that the coxite baculi do not extend so far posteriorly in *R. dominica* and that the anal opening is covered by a flap not raised above the general level of the genital tube, whereas in *P. stouti* the anus is represented as opening on the end of a papilla-like projection from the dorsal surface of the genital tube. The tenth sternite is not represented in *P. stouti.*

In *Polycaon stouti*, Tanner (*loc. cit.*) calls the part of the tube containing the baculi the ninth segment. In most of the other forms, which he studied, he applied this term to that part of the tube which apparently corresponds with the more anterior membranous part of the tube; it is this latter nomenclature that I have adopted for *R. dominica.*

Basing his conclusions, drawn from his study of the female genitalia, on the affinities of these structures, Tanner (1927) divided the Coleoptera into three suborders and nine series. The BOSTRYCHIDAE are placed by him in the Melyrid group of the Cantharid series of the suborder Polyphaga.

The characters given for the Melyrid group are, that the stylus is small and borne on the end of a coxite, which shows signs of secondary division. The valvifer is reduced to a long baculum, which articulates with a short baculum of the coxite. The paraproct is also reduced to a baculum.

The genitalia of this group are termed elongate, as opposed to those of other groups which contain no baculi.

Rhizopertha dominica has been placed in various groups by different authors. This association with insects of widely differing genera is undoubtedly the result of a superficial similarity of appearance and similarity of habits. The confusion thus caused is apparent throughout the literature on *R. dominica.* Fabricius placed it among the Lamellicorns under the genus *Sinodendron,* which genus is now included in the LUCANIDAE. This family is composed of wood-boring beetles having the same general shape as the BOSTRYCHIDAE. Fabricius, in this classification, placed *Rhizopertha* next to *Apate,* another true Bostrychid genus, the habits of which have brought about the typical modifications associated with wood-boring species.

Marsham (1802) under the synonyms of *Ptinus piceus* and *P. fissicornis* has similarly connected *R. dominica* with another group of beetles containing wood-borers.

Stephens (1830) placed *Rhizopertha* in its correct position in the BOSTRYCHIDAE together with the genera *Sinoxylon, Dinoderus* and *Apate,* but under this head he also included the Scolytid genus *Trypodendron,* which contains wood-boring species.

Wollaston (1854), not recognising Stephens' classification, placed the beetle under the name of *Rhizopertha pusilla* in the family CISSIDAE (CIOIDAE), which includes beetles feeding on rotten wood and fungus. Taschenberg (1879), using the same synonym as Wollaston, included it in the ANOBIIDAE next to the genus *Ptilinus.* The ANOBIIDAE contains wood-borers, and is sometimes grouped with the PTINIDAE. *Rhizopertha* is placed in the PTINIDAE by Cotes (1891 and 1896), again under the synonym of *Rhizopertha pusilla.*

R. dominica is now generally recognised as a Bostrychid beetle closely related to the genus *Dinoderus.* It resembles *Dinoderus minutus* very closely in external structural characters. The species may be distinguished from each other by the fact that *Dinoderus minutus* is considerably broader than *R. dominica.* It is important that the similarity between the two be recognised, since they both attack stored products. *Dinoderus* is frequently found imported on Jamaica root ginger. I have also bred it on maize, a food on which it is recorded by Lesne (1924 (*b*)).

Lesne (1924 (*b*)) placed *R. dominica* in the genus *Rhizopertha,* of which it is the only known species. This genus is included in the subfamily DINODERITAE, which also includes *Dinoderus, Dinoderopsis, Stephanopachys* and *Prostephanus.* The subfamily DINODERITAE is included in the family BOSTRYCHIDAE.

The general characters of the DINODERITAE as given by Lesne (1924) are as follows :—

" Size small. Body cylindrical, very often carrying upstanding thick, stiff, short hairs on the dorsal surface.

" Head carried under the prothorax and not visible from above, marked by a strong transverse furrow between the eyes. Vertex glistening, without tubercles or ridges. Club of the antenna of three segments, all sparely covered with hairs. Labrum large, situated in a plane making an angle with that of the clypeus. Hairs of the galea confined to its apical extremity, not longer at the internal side than the external side. Intermaxilla well developed. Labium with paraglossae.

" Pronotum very convex, steep in front and having uneven ridges in this region. Prothoracic horns always absent.

"Anterior coxae transverse, slightly projecting, contiguous or almost contiguous with no prosternal lobe between. Last segment of the tarsus as long as the preceding segments put together. Segments 2–4 subequal. Intercoxal projection from the abdomen tabular and very narrow.

"Ovipositor long and slender.

"Anal cell of the wings not divided."

Lesne's observations on the mandibles of the DINODERITAE have been omitted purposely, since they do not apply in the case of *R. dominica.*

Owing to the fact that *Dinoderus minutus* is a pest of stored products and is likely to be met with, together with *Rhizopertha dominica,* that part of the key of Lesne (1924 (*b*)) separating the two genera is quoted here.

"Frons not as long as the clypeus, bounded anteriorly by a fine suture. Last visible sternum of the abdomen entire, truncated posteriorly. Pygidium invisible from below. Posterior area of the pronotum covered with rough tubercles. Body elongated . . . . *Rhizopertha.*

"Frons extremely short, without anterior limiting suture. Last visible abdominal sternum cut out in the arc of a circle in the middle of the posterior border, to take the pygidium, which in repose is visible from below. Posterior area of the pronotum punctured, body short and broad . . . *Dinoderus.*"

A further difference between *R. dominica* and *D. minutus* lies in the shape of the scutellum of the mesothorax. The scutellum in *Rhizopertha* is approximately square, whereas in *D. minutus* it is twice as wide as it is long.

According to Lesne (1924 (*b*)) the following are the diagnostic characters of the genus *Rhizopertha.* The genus contains only one species, *R. dominica.* Body elongated. Fronto-clypeal suture well marked, not raised up; frons half as long as the epistome; antenna of 10 segments, with a club formed of subequal segments, which are covered evenly with pores and hairs. Labrum truncate anteriorly. Mentum short with a blunt projection in the middle; last segment of the labial palps swollen out. Pronotum rounded at the anterior border, where it is furnished with an unbroken row of teeth; the sloping anterior surface is covered all over with little sharp teeth; the posterior surface is covered with large squat tubercles. The apical slope of the elytra is regularly convex without marginal tubercles and is covered with short arched hairs; lower apical border jutting out. Last visible abdominal sternite complete. Pygidium invisible from below.

NATURAL ENEMIES.

The natural enemies of *R. dominica* may be grouped under three heads :—

1. Fungi
2. Predacious mites
3. Hymenopterous parasites.

R. dominica will not flourish in a culture that has become mouldy. It does not induce mouldiness in grain in the same way as the species of *Calandra* and does not seem able to combat mould as well as these weevils.

Predacious mites may attack the eggs and larvae of *R. dominica* and seriously reduce its numbers or even entirely destroy it in a culture. The conditions required for the existence of these animals in large numbers, however, are such that they are not likely to be a serious enemy of the beetle under field conditions. Goodrich (1921) recorded *Pediculoides* mites feeding on the beetle larvae. The predacious mite found feeding on the beetle in the incubator was *Cheyletus eruditus* Schrank.

The Hymenopterous parasites of *R. dominica* have not been very fully studied. The first record of a parasite attacking *R. dominica* is that of Goodrich (1921), who says that *Lariophagus distinguendus* (Först.), a Chalcid, attacks *R. dominica*, together with *Calandra granaria* and *C. oryzae*. Goodrich states that *Lariophagus* attacks the larval or more rarely the pupal stage. In addition, in this paper, *Chaetospila elegans* (Westwood) is quoted as possibly attacking *Rhizopertha*, although the evidence is not conclusive.

Waterston (1921) in the same paper gave some systematic notes on these parasites with figures and keys. Durrant (1921) found *Lariophagus distinguendus* in wheat which contained *R. dominica* among other pests of wheat.

Lariophagus distinguendus is chiefly a parasite of *Calandra granaria*, *C. oryzae* and *Sitodrepa panicea*, and it is in this connection that it has been dealt with by Hase (1919 and 1924) and Ruschka (1921). Hase described the biology and habits, while Ruschka dealt with the synonymy and systematics.

In 1930 an attempt was made to rear parasites of the genus *Trichogramma* on *R. dominica*, in connection with the control of codlin moth in Australia (Evans 1930); it was a failure and it was said that none of the eggs, even, was parasitised.

Cephalonomia waterstoni (Gahan) has been recorded from shipments of grain containing *R. dominica*, amongst other insects (Gahan 1931). No data is available as to its capacity or otherwise to attack the beetle.

SUMMARY.

(*a*) An account is given of the nomenclature and synonymy of the Bostrychid beetle, *Rhizopertha dominica* (Fabricius), from the literature.

(*b*) A detailed account of the distribution is given, together with some remarks on the original home of the species and on the areas in which it is able to exist throughout the year under natural conditions.

(*c*) A list of the substances recorded as food for *Rhizopertha* is given together with an account of some laboratory experiments on the nature of its food and feeding habits. The problem of what substance formed its original food is discussed.

(*d*) An account is given of the life-history of specimens fed on synthetic whole-meal flour under controlled conditions of temperature and humidity. A comparative description of the larval instars is given, together with a description of the egg, the prepupa and the pupa. Characters are given for distinguishing the sexes in the pupal stage.

(*e*) A detailed description of the mature larva and adult beetle is given. An account of their systematic position is taken from the literature. The adult male and female genitalia are described in detail. The light thrown by these structures on the phylogeny of the species is discussed.

(*f*) The natural enemies recorded as attacking *R. dominica* are given, with some account of *Lariophagus distinguendus* Först., a Chalcid parasite. References are given to the literature on *L. distinguendus*.

(*g*) A list of references to the species is given.

LIST OF PAPERS REFERRED TO.

BACK, E. A., and COTTON, R. T. 1922. Stored Grain Pests. *Fmrs'. Bull. U.S. Dep. Agric.*, **1260**: 10–17.

——. 1924. Effective use of HCN gas in the protection of chick peas. *J. agric. Res.*, **28**: 649–660, 1 pl., 1 fig., 3 tables.

Back, E. A., and Cotton, R. T. 1931. Stored Grain Pests. *Fmrs'. Bull. U.S. Dep. Agric.*, **1260 revd.** : 7–9.

Barnes, J. H., and Grove, A. J. 1916. The insects attacking stored wheat in the Punjab and the methods of combating them, including a chapter on the chemistry of respiration. *Mem. Dep. Agric. India* (*Chem. Ser.*), **4** : 166–167, 169–172.

Bekman, I. 1929. Observations on the introduction of seed pests. (In Russian.) *Izv. prikl. Ent.*, **4** (1) : 101–166. (With a summary in German.)

Billups, T. R. 1879. Occurrence in a granary of *Calandra oryzae* and its associates. *Entomologist*, **12** : 268.

Böving, A. G. 1922. Taxonomy and Morphology of the Larval Stages of *Scobicia declivis* Leconte. *Appendix to* Burke, H. E., Hartman, R. D., and Snyder, T. E. The Lead Cable Borer or "Short-Circuit Beetle" in California. *U.S. Dept. Agric. Bull.*, **1107**.

—— and Craighead, F. C. 1931. Larval forms of the order Coleoptera. *Ent. amer.*, **11** : 14, 62.

Burgeon, L. 1930. Les Bostryches. *Rev. Zool. Bot. afric.*, **20** : (20)–(24).

Chittenden, F. H. 1911. The lesser grain-borer and the larger grain-borer. *Bull. U.S. Bur. Ent.*, **96** : 29–47, figs. 7, 8.

——. 1919. *Bull. U.S. Dep. Agric.*, **783.**

Cotes, E. C. 1889. *Ind. Mus. Notes*, **1** : 60.

——. 1891. *Ibid.*, **2** : 27, 150.

——. 1896. *Ibid.*, **3** : 124.

Doane, R. W. 1919. Weevils in Australian wheat in California. *J. econ. Ent.*, **12** : 308, 312.

Dupont, P. R. 1916. Insect Notes. *Ann. Rep. Agric. & Crown Lands Seychelles*, **1915** : 20–22.

Durrant, J. H. 1921. Insects associated with grain, etc. *Rep. Grain Pests* (*War*) *Committee*, **9** : 33, 35, 37, 38, 46–48.

—— and Beveridge, W. 1913. A preliminary report of the temperature reached in army biscuits during baking. *J.R. Army Med. Corps*, **20** : 615–634.

Duval, J. 1859–1863. *Genera des Coléoptères d'Europe*, **3** (p. 167 of catalogue).

—— and Fairmaire, L. M. H. 1859–1863*b*. *Ibid.*, **3** : 251.

Ehrhorn, E. M. 1919. Report of the Chief Plant Inspector. *Rep. Hawaii Bd. Agric. & For.*, **1917–18** : 61–85.

Evans, J. W. 1930. An attempt to rear parasites of genus *Trichogramma* on *Rhizopertha dominica*. *J. Coun. Sci. indust. Res. Austr.*, **3** : 109.

Fabricius, J. C. 1792. *Entomologiae Systematicae*, **1** (2) : 359.

——. 1798. *Ibid. Supplementum*, **1** : 156.

Fairmaire, L. M. H. 1850. Essai sur les Coléoptères de la Polynésie. *Rev. Mag. Zool.*, (2) **2** : 50.

Fauvel, A. 1878. *Annuaire entomologique*, **1878** : 108.

Fitch, E. A. 1879. Granary weevils *Sitophilus granarius* and *S. oryzae*. *Entomologist*, **12** : 45.

Fletcher, T. B. 1914. *Some South Indian Insects*. Madras, Govt. Press.

—— and Ghosh, C. C. 1921. Stored grain pests. *Bull. agric. Res. Inst. Pusa*, **3.**

Froggatt, W. W. 1918. A serious pest of stored wheat—the lesser grain borer
VII 132 (*Rhizopertha dominica*). *Agric. Gaz. N.S.W.*, **29** : 726–728.

Gahan, A. B. 1931. On certain Hymenopterous parasites of stored grain insects.
XIX 495 *J. Wash. Acad. Sci.*, **21** : 219–220.

Gardner, J. C. M. 1933. Immature stages of Indian Coleoptera (13) Bostrychidae. *Ind. For. Rec.*, **18** (9).

Ghosh, C. C. 1925. Report of the Entomologist Mandalay and sericultural work for year ended 30th June, 1925. Rangoon.

Goodrich, E. S. 1921. Note on the Hymenoptera parasitic in beetles infesting
X 106 grain. *Rep. Grain Pests* (*War*) *Committee*, **9** : 5–7.

GORHAM, H. S. 1883. *Biologia centrali Americana* Coleoptera, **3** (2) : 217.

GURNEY, W. B. 1918. Insect pests of maize. *Agric. Gaz. N.S.W.*, **29** : 641–650, 11 figs. vii 84

HAMILTON, J. 1894. *Trans. Amer. ent. Soc.*, **21** : 393.

HASE, A. 1919. Beiträge zur morphologischen und biologischen Kenntnis der Schlupfwespe *Lariophagus distinguendus* (Först.). *S.B. Ges. naturf. Freunde Berl.*, **1919** : 402–432, 10 figs.

——. 1924. Zur Kenntnis wirtschaftlich wichtiger Tierformen 1. Ueber den Stech und Legeakt sowie über den Wirtwechsel von *Lariophagus distinguendus. Naturwissenschaften*, **12** : 377–384.

HOFFMAN, W. A. 1933. *Rhizopertha dominica* as a library pest. *J. econ. Ent.*, **26** : 293–294.

HOPE, F. W. 1845-1847. Descriptions of new Coleoptera sent from China. *Trans. ent. Soc. Lond.*, **4** : 17.

HOPKINS, A. D. 1909. Bark beetles of the genus *Dendroctonus*. *Bull. U.S. Bur. Ent.*, **83** : 11.

HORN, G. H. 1878. *Proc. Amer. phil. Soc.*, **1878** : 548, 550.

JOY, N. H. 1932. *A Practical Handbook of British Beetles* : 459–460, pl. 131, 13.

KEMPERS, K. J. W. B. 1923. Abbildungen von Flügelgeäder der Coleopteren. *Ent. Mitt. Berlin*, **12** : 94.

KUNHI-KANNAN, K. 1919. Pulse beetles (store forms). *Bull. Mysore State Dep. Agric.* (Ent. Ser.), **6** : 31 pp. 18 figs.

KIESENWETTER, H. v. 1898. *Naturgeschichte der Insekten Deutschlands, Coleoptera*, **5** : 40–41.

LACORDAIRE, T. 1857. *Genera des Coléoptères*, **4** : 534, 541.

LECONTE, J. L. 1862. Classification of the Coleoptera of North America. 1. *Smithson. misc. Coll.*, **3** : 207–208.

—— and HORN, G. H. 1883. Classification of the Coleoptera of North America. *Ibid.*, **26** : 228 pp.

LENG, C. W. 1920. Catalogue of the Coleoptera of North America.

LESNE, P. 1896. Contributions à la faune indo-chinoise. 17. Bostrychidae. *Ann. Soc. ent. Fr.*, **65** : 511.

——. 1897. *Ann. Soc. ent. Fr.*, **66** : 332–333.

——. 1898. Liste des Bostrychides des collections du musée Civique de Gênes. *Ann. Mus. Genova*, **39** : 628–638.

——. 1900–1906. Supplément au Synopsis des Bostrychides paléarctiques. *Abeille*, **30**.

——. 1910–1911. Liste des Bostrychides et Lyctides de Java. *Notes Leyden Mus.*, **33** : 71.

——. 1911. Régime alimentaire chez les Bostrychides. *C.R. Acad. Sci.*, **152** : 625.

——. 1924*a*. *C.R. Soc. Biogeog.*, **1924** : 21–23.

——. 1924*b*. Les coléoptères Bostrychides de l'Afrique tropicale française. *Encyclop. ent.*, A **3** : 49–50.

——. 1929. Bostrychids collected in Italian Somaliland by the G. Paoli Mission. *Mem. Soc. ent. Ital.*, **8** : 66–68.

——. 1932. *Ann. Soc. ent. Fr.*, **101** : 1–24.

LUCAS, H. 1849. *L'Histoire Naturelle des animaux articulés de l'Algérie.* (1) Coléoptères : 468.

LUNARDONI, A. 1889. *Gli insetti nocivi di nostri campi, orti, frutteri e boschi*, &c., **1** : 640.

MARSHAM, T. 1802. *Ent. Brit.*, **1** : 82, 88.

MASKEW, F. 1920. Quarantine division, reports for the months July and August 1920. *Mon. Bull. Calif. Dep. Agric.*, **9** : 388, 392.

MASKEW, F., and STRONG, L. A. 1920. *Mon. Bull. Calif. Dep. Agric.*, **9** : 721–735.

MACDOUGALL, R. S. 1926. Insect and other invertebrate pests of 1925. *Trans. Highl. agric. Soc. Scotland*, (5) **38** : 151–194, 27 figs.

Motschulsky, V. 1857. *Etudes Entomologiques*, **6** : 78.

Munro, J. W. 1915. The larvae of the furniture beetles, families Anobiidae and Lyctidae. *Proc. Roy. Soc. Edinb.*, **19**.

Neiswander, C. R. 1931. The sources of American corn insects. *Bull. Ohio agric. Exp. Sta.*, **473** : 51, 64.

New South Wales. 1924. Proclamations under the Plant Diseases Act, 1924. *Govt. Gaz.*, **97**.

Redtenbacher, L. 1858. *Fauna Austriaca.* Die Käfer : 570 (2te Auflage).

Reitter, E. 1890. *Verh. nat. Ver. Brunn*, **27** : 112.

——. 1906. *Catalogus Coleopterorum Europae.* : 422.

Riley, W. A. 1882. *Dinoderus pusillus* feeding on cork. *Amer. Nat.*, **16** : 747.

Roberts, A. W. R. 1930. A key to the principal families of Coleoptera in the larval stage. *Bull. ent. Res.*, **21** : 47–72.

Ruschka, F. 1921. Zur Morphologie und Systematik des Kornkäfer-Chalcidiers *Lariophagus distinguendus* Först. *Z. angew. Ent.*, **7** : 463.

Schwardt, H. H. 1931. The lesser grain borer. *Bull. Arkansas agric. Exp. Sta.*, **268** : 48. xx 126

——. 1933. Life history of the lesser grain borer (*Rhizopertha dominica*). *J. Kansas ent. Soc.*, **6** : 61–66.

Sharp, D., and Muir, F. 1912. Male genitalia of beetles. *Trans. ent. Soc. Lond.*, **1912** : 353, 481, 482.

Simmonds, H. W. 1923. Report of the acting Entomologist for the year 1923. *Ann. Rep. Fiji Dep. Agric.*, **1923** : 8.

Stebbing, E. P. 1903. *Ind. Mus. Notes*, **6** : 19, 20, 25, 26.

Stephens, J. F. 1830. *Illustrations of British Entomology*, **3** : 354.

Strong, L. A. 1921. Quarantine Division Reports for July and August 1921. *Mon. Bull. Calif. Dep. Agric.*, **10** : 381.

Takahashi, S. 1931*a*. Introductory notes on the heat of stored grain produced by injurious insects. (In Japanese.) *Insect World*, **35** : 8–12, 44–49, 74–78.

——. 1931*b*. *Insect pests of stored rice and their control.* Appendix. Insect pests of stored crops. (In Japanese.) Tokyo, 201 pp., 10 pls., 44 figs.

Tanner, V. M. 1927. A preliminary study of the genitalia of female Coleoptera. *Trans. Amer. ent. Soc.*, **53** : 5.

Taschenberg, E. L. 1879. *Praktische Insektenkunde*, **2** : 84.

Tucker, E. S. 1909. *Yearb. U.S. Dep. Agric.*, **1908** : 579.

——. 1912. *Rep. Dep. Ent. Louisiana St.*, **1912** : 17–20.

Verhoeff, C. 1918. Morphologie des Abdomens der Coleoptera und über die phylogenetische Bedeutung desselben. *Z. wiss. Zool.*, **117** : 130–204.

Wallace, A. R. 1876. *The Geographical Distribution of animals.* **1.**

Waterhouse, C. O. 1888. Some observations on the Coleopterous family Bostrychidae. *Ann. Mag. nat. Hist.*, (6) **1** : 349.

Weir, J. J. 1874. *Ent. mon. Mag.*, **10** : 259.

Willcocks, F. C. 1910. Insects injurious to stored grains, seeds, etc., with special reference to their occurrence in Egypt. *Yearb. Khediv. agric. Soc. Cairo*, **1909** : 195–227.

——. 1922. *A survey of the more important economic insects and mites of Egypt* : 363, 375.

Wollaston, L. V. 1854. *Insecta Maderensa* : 286–288.

Zacher, F. 1930. Käfer an Tapiokawurzeln. *Mitt. Ges. Vorratsschutz*, **6** : 53–56.

——. 1932. Brazilianische Speicherschädlinge. *Mitt. Ges. Vorratsschutz*, **8** : 68–72.

Zoufal, V. 1894. Bestimmungs-Tabelle der Bostrychidae aus Europa und den angrenzenden Ländern. *Wien. ent. Ztg.*, **13** : 33–42.

THE GENUS *APTINOTHRIPS* HALIDAY (THYSANOPTERA: TEREBRANTIA)

By E. R. Speyer, M.A.

(*Entomologist, Experimental Station, Cheshunt, Herts.*)

[Read 1st May, 1935.]

With Plate XIV and Twenty-nine Text-figures.

Contents.

PAGE

Introduction 483

Derivation.—Appearance and habit.—*A. rufus* (Gmel.) Hal. and *A. stylifer* Tryb. two separate species.—*A. rufus* and *A. nitidulus* Hal. structurally similar.—*A. elegans* Pr. and var. *mediterranea* Pr. probably the same species.—" Styled " and " Unstyled " Antennae. Methods of preparation.

Acknowledgements 486

I. *A. rufus* (Gmel.) Hal. as Type Species of the Genus . . . 486

(1) Synonymy. (2) History. (3) Description of the imagines.

II. Structural Characteristics of the Genus 493

III. The Species of the Genus *Aptinothrips* 493

(*a*) Preliminary remarks. (*b*) Characters for separation of the Imagines. (*c*) Diagnostic characters for the Imagines. (*d*) Tabular Key. (*e*) Variation and Aberration.

IV. Habitat and Distribution 501

V. Young Stages of the Genus *Aptinothrips* 503

Literature referred to in the Text 508

Introduction.

The Genus *Aptinothrips* was raised by Haliday in 1836; by its derivation from the Greek "*ἀπτῆν*," meaning "wingless," the correct name should be Apt*e*nothrips, which has indeed been used by O. John, but Haliday's spelling, adopted in all his descriptions, has been in general use for so many years that a correction is now considered to be most inadvisable. The Greek "Θριψ" being of masculine gender, masculine terminations for specific names are here employed.

On account of the very limited allusion to structural characteristics given in descriptions of Thysanopteran genera, it is not possible at present to touch upon the affinities of *Aptinothrips* to other genera. This genus clearly belongs to the family Thripidae. The few species at present known are small, slender, wingless insects of a "Thrips"-like form: they are of a yellow, rarely a brown, colour, and usually live, in all the stages of their life-history, which conforms to that of other Terebrantia, on various grasses, often in such profusion that they may possibly be of some economic importance. In correlation with the apterous condition, ocelli upon the head of the imagines are wanting. Both larvae and imagines are incapable of moving by leaps, a habit which is common to so many of the Terebrantia.

Throughout the genus there is a strong tendency to parthenogenetic reproduction : males of the commonest species are far from easy to obtain. Dr. G. Morison collecting over a period of six years in Scotland found only 3 males of the species *A. stylifer* Trybom amongst more than 900 females. Hitherto the chief interest in these insects has been centred in the possibility of the existence of two distinct biological races of the common *A. rufus* (Gmel.) Hal., the one possessing 6-jointed, and the other 8-jointed antennae.

Priesner (1921) suggested that the appearance of the two forms might depend upon conditions of moisture and temperature to which the insects were exposed, a view which was at least partially adhered to recently by U. S. Sharga (1933).

Working on lines similar to those adopted for the determination of certain species of the genus *Thrips* (Speyer 1934), it is now clear that certain characteristics of the abdominal chaetotaxy of the imagines are correlated in each form with the type of antenna; differences in the chaetotaxy between the larvae and pupae of the two have now also been established. It is certain, therefore, that two entirely distinct species are represented, and that no question of biological race is involved. The one species is *A. rufus* (Gmel.) Hal., the other *A. stylifer* Trybom, the former possessing 6-jointed and the latter 8-jointed antennae in the imaginal stage. On similar lines, diagnostic characters have been ascertained for the imagines of other species of the genus.

No differences of structure whatever appear to exist in any of the corresponding stages of the life-history between the common meadow-inhabiting *A. rufus*, and the darkly coloured (and sometimes smaller) *A. nitidulus* Hal., which occurs on some halophytic plants growing between coastal tide-marks and in salt-marshes. The two are therefore treated as one and the same species.

Dr. G. Morison has made observations on both forms particularly upon the Scottish coast, and draws the following conclusions therefrom :—

1. The life-history as judged by captures of different instars during the year, appears to be similar in both forms.
2. In its usual habitat, *i.e.* on grass growing on a well-drained soil and not very close to salt-water, the light form is very constant in coloration, but it may breed in small numbers, retaining its light colour, in the typical habitat of the dark form, *i.e.* grass, chiefly *Glyceria maritima*, which is submerged at high tide.
3. Intermediates between the two forms occur most abundantly on grass close to salt-water.
4. The dark form is constant in coloration when living on grass submerged at high tide, but has lived and bred, though very sparingly, retaining its dark colour, for a period of more than one year on *Glyceria maritima* transplanted from the seashore to a locality 300 feet above sea-level.

In Dr. Morison's collection is a long series of specimens which *appear* to show every gradation in colour between the two forms, but owing to the lighter colour of the insects shortly after ecdysis, it is not quite certain that this gradation is a true one.

Dr. Priesner (1924–25) recorded some tendency to darkening of colour in *A. rufus* collected from *Ammophila arenarius* at Spiekeroog, one of the East Frisian Islands, but failed to obtain the true dark coloured form in this locality.

From the evidence presented, the relationship between the two forms remains quite obscure, but it is very obviously impracticable to regard the two either as distinct species, or as distinct varieties or races of a single species.

For the present it is best to assume that under certain conditions, not entirely attributable to environmental change, *A. rufus* tends to become dark in colour.

The shape of the 1st and particularly of the 2nd imaginal antennal joints would at first sight appear to present marked characteristics by which the different species of the genus might be separated from one another. Though these joints are, except in rare instances, not specially modified and are practically similar in *A. rufus* and *A. stylifer*, both are usually of most peculiar shape in *A. elegans* Priesner and *A. karnyi* John. As a means of determining specimens, it is unfortunate that these characteristics are not constant, for the shape of these joints in *A. rufus* sometimes approaches to that found in *A. elegans*, and the case is similar between *A. stylifer* and *A. karnyi*. With reference to *A. elegans* it is considered that a variety named *mediterranea* by Dr. Priesner shows a definite transition between the modified and the unmodified types of these joints : this variety differs from *A. rufus* (and exactly resembles *A. elegans*) in certain characteristics of the abdominal chaetotaxy (and of the antennal sense organs of the male), which, so far as can possibly be judged, are constant. Little importance is therefore attached to the shape of the antennal joints, and it is considered best to regard *A. elegans* Priesner and *mediterranea* as one and the same species.

The dimensions of certain spine-like setae upon the 9th abdominal tergite of the male imago have been found to be inconstant in *A. rufus* and are therefore held to be of no diagnostic value : the chaetotaxy of this segment appears, in the male sex, to be of generic rather than of specific importance.

With reference to the much discussed antennal style of *A. stylifer*, it may be stated that there is no approach from the styled (8-jointed) towards the unstyled (6-jointed) type of antenna or vice versa in this genus. Dr. Morison affirms that the antennae of *A. rufus* are more subject to malformation (tending to a *reduction* of the number of joints) than those of any other Thysanopteron known to him, yet he has not observed a single instance in which the terminal portion of the antenna makes the slightest approach towards that obtaining in *A. stylifer*.

Dr. Priesner and Mr. Sharga have recorded instances in which the antennal style of *A. stylifer* is constituted of a single joint only, but such reduction occurs frequently in species of other genera which possess a 2-jointed antennal style (e.g. *Frankliniella* and *Taeniothrips*). The styled antenna, as opposed to the unstyled, becomes therefore a constant diagnostic character which is convenient for dividing the genus into two groups, but owing to the general similarity of structure in all the species, it is considered undesirable to raise a new genus for the group which possesses a styled antenna.

Of *A. melanophthalmus* Bagnall there exists only the single type specimen : from such portions of the chaetotaxy as are observable, it is doubtful if this insect should be included in the genus, but it is provisionally retained here until more material becomes available.

Of the young stages, only larvae and pupae of *A. rufus* have been obtainable in quantity : sufficient numbers of 2nd instar larvae of *A. stylifer* have been examined to establish constant differences from those of the former species, but only one pupa, collected by Dr. Morison, which is in good condition and which shows an important structural difference on the 9th abdominal segment from that of *A. rufus*.

The characteristics of structure essential for the separation of species of this genus are seldom exhibited clearly in canada-balsam mounts. The most convenient and satisfactory method of preparation has been as follows :—

For the imagines : immersion for at least six hours in 10% to 15% cold solution of potassium hydroxide, thorough washing in distilled water, and finally mounting in Faure's medium between two cover-glasses (Speyer 1934, p. 134).

For the young stages: immersion for four hours in 5% cold solution of potassium hydroxide, washing in distilled water, and transference first to 20% and then to 50% glycerine prior to mounting in Faure's medium. (This method was suggested by Dr. Morison following Mönnig's formula.)

ACKNOWLEDGEMENTS.

Mr. F. Laing and the authorities of the British Museum (Natural History) placed the whole collection of Thysanoptera in the National collection at my disposal for study. This collection contains a considerable amount of material of the genus *Aptinothrips* assembled principally by Dr. R. S. Bagnall and Mr. O. John. Dr. G. Morison of Marischal College, Aberdeen, and Dr. C. B. Williams of the Rothamsted Experimental Station both sent the whole of their valuable, in the case of the former it should be stated, invaluable, collections of this genus. Dr. H. Priesner, of the Ministry of Agriculture, Cairo, not only loaned his type specimens of rare species which he sent from Egypt, but expressed his willingness to send his whole collection of the genus. Owing to this collection being in Austria, this generous offer could not be effected prior to publication of this paper. Dr. Priesner and Dr. Morison have also given advice and information which have been of the greatest value. To all these gentlemen, I tender my sincerest thanks, and acknowledge their great generosity, whereby exceptional advantages for the study of this genus have been proffered to me. Above all, however, the kindness of Mr. Laing stands out for his invaluable advice and direction, based upon long and careful experience of nomenclature and systematic learning. He has spent much time and unlimited trouble in criticising and advising upon every aspect of the subject here presented: through him I have had access to all the literature quoted in the synonymies. I also express my thanks to the Assistant Director of the Irish National Museum, Dublin, for valuable information relating to the few specimens still remaining in Haliday's collection, to Miss A. M. Lysaght, of Rothamsted, for collecting very useful specimens, and to Mr. G. A. H. Helson for obtaining a specimen of *Aptinothrips* for me in New Zealand.

I. *APTINOTHRIPS RUFUS* (GMELIN) HALIDAY.

Type Species of the Genus.

(1) *Synonymy.*

rufa Gmelin, 1788, *Linné Systema Nat.*: 2224.
rufa Nicholson, 179–, *J. nat. Phil.*, **12** : pl. viii, fig. 1.
rufa Haliday, 1836, *Ent. Mag.*, **3** : 445–6.
nitidula Haliday, 1836, *loc. cit.*, **3** : 446.
nitidula Haliday, 1837, *loc. cit.*, **4** : 146.
rufa Haliday & Walker, 1852, *Homopt. Ins. Brit. Mus.*, **4** : 1104–5, pl. v, figs. 5–11.
nitidula Haliday & Walker, 1852, *loc. cit.*, **4** : 1105.
var. *connaticornis* Uzel, 1895, *Mon. Thysanopt.*: 152–4, Tab. vi, fig. 79.
nitidulus Uzel, 1895, *loc. cit.*, 154.
var. *connatticornis* Hinds, 1902, *Proc. U.S. Nat. Mus.*, **26** : 167, pl. v, fig. 54.
nitidula Bagnall, 1908, *Ent. Mon. Mag.*, **19** : 6.
nitidulus Bagnall, 1909, *J. econ. Biol.*, **4** : 39.
nitidulus Bagnall, 1911, *loc. cit.*, **6** : 10.
nitidulus Bagnall, 1912, *loc. cit.*, **7** : 194.
nitidulus Bagnall, 1913, *Scott. Nat.*, **1913** : 38.

nitidulus Bagnall, 1913, *J. econ. Biol.*, **8** : 235.
rufus Priesner, 1921, *Ent. JahrB.*, **1921** : 162–166.
rufus Priesner, 1926–28, *Thysanopt. Europ.* : 156–8, Taf. III, fig. 38.
nitidulus Priesner, 1926–28, *Thysanopt. Europ.* : 162–3; 708.
var. *connaticornis* Radulesco, 1930, *Rev. Path. vég. Ent. agric.*, **17** : 24–8.
rufus Sharga, 1933, *Ann. appl. Biol.*, **20** : 308–326.

This synonymy, largely compiled from Dr. Priesner's Monograph, makes no pretence of being complete, but attempts to avoid all confusion which has arisen in the past between the species *A. rufus* (Gmel.) Hal. and *A. stylifer* Tryb. The reasons for sinking Haliday's species "*nitidulus*" have been set out in the introduction to this paper.

(2) *History.*

Haliday, in 1836, considered Gmelin's *rufa* of 1788 (based on von Gleichen's figure of 1764) to be applicable to specimens collected by him. It is doubtful if any of these now exist: eight specimens in what remains of Haliday's collection in the Irish National Museum, Dublin, are labelled "*rufa*," but not by Haliday. Some further specimens in the British Museum (Natural History) labelled "*rufa*, British? 82–39" are all female imagines of the species *A. stylifer* Trybom, and do not tally with any description given by Haliday for the genus or any of its species.

Von Gleichen's description being pre-Linnaean, and both this and Gmelin's inadequate, I consider that the authority for the species should be *A. rufus* (Gmelin) Haliday.

Gmelin (1788) gave the name *rufa* and added :—"Habitat in tritici spicis, an forsan larva minutissimae." This refers to W. F. von Gleichen's figures and description of 1764, *Neuestes aus dem Reiche der Pflanzen* : 13–14, Tab. xvi, figs. 6 and 7.

The enlarged figure 7 depicts certainly a larval Thysanopteron of a bright red colour. In the text it is stated that the insect was collected from *Triticum*, which suggests that the figure might equally apply to the larva of *Limothrips cerealium* Hal. Haliday's opinion, whether rightly or wrongly expressed, must be accepted. Haliday (1836, p. 446) says of Nicholson's (179–?) figure, "(very bad)": the volume in which it appeared does not now seem to be available.

Haliday's descriptions of the genus and species are now given, including those of his species *nitidulus*, which, for reasons stated previously, is considered to be synonymous with *A. rufus* (Gmel.) Hal.

"*1836* (*pp. 445–6*).

Subgen. (of *Thrips*) III. *Aptinothrips.*

Prothorax aequilatus : ocelli nulli nec alae : antennae articulus 6tus apice attenuatus, absque stylo articulato.

Sp. 4. *Thr. Apt. rufa.* Fem. Fulva oculis et rostris apice fuscis.

In profusion in the spikes of grass and cerealia.

Sp. 5. *Thr. Apt. nitidula.* Fem. Testacea abdominis incisuris, &c. fuscis. One half smaller than the preceding. Found on a muddy sea-coast, I believe on the heads of *Plantago maritima*, but not common.

1837 (*p. 146*).

Sp. 5. *Thr. Apt. nitidula.* Shorter than *Thr. rufa*, dusky chestnut, with the eyes and incisures of the abdomen darker; the antennae (except the sixth joint) with the shanks and feet paler.

1852 (pp. 1104–5).

Subgenus I. *Aptinothrips.*

Antennae apicula connata.

Antennae articulo 6^{to} longiore apice attenuato-exannulato: ocelli nulli: corpus lineari glabrum, abdominis dorso efoveolato: alarum ne minimo quidem vestigii.

1. *Aptinothrips rufa.*

Ferruginea oculis et rostri apice fuscis foem: pallidi flava, abdomine glandulis geminis croceis perlucentibus, segmento penultimo ante apicem medium bispinoso mas. Long. foem $\frac{2}{3}$–$\frac{3}{4}$ lin.

Hab. In gramine et cerealibus.

a. England. Presented by F. Walker, Esq.

My brief description (1836) of *Aptin. rufa* induced Burmeister to set it down as a larva without doubt: but rashly, for the exarticulate apex of the antennae is no indication of this state, as he seems to infer. It is a perfect insect with compound eyes, smooth coriaceous integuments, connected segments of the pterothorax and prominent humeral angles and a perfect ovipositor. For the greater certainty I took pains to trace its history, and have reared it from the larva, which I have figured, as well as the propupa and pupa. For a long time, indeed, I sought the other sex in vain, and was almost induced to fancy that like *Cynips*, the insect might be unisexual. But remembering that at some seasons males may occur of *Limothrips*, I did not give up the search, and guided by that indication I at last, at the season of hay-harvest, discovered the male, though excessively rare, I may say not a single one to several hundreds of the female. . . . Haliday MSS.

2. *Aptinothrips nitidula.*

Fusco ferruginea, abdominis incisuris fuscis. Long. $\frac{1}{2}$ lin.

Hab. In plantis maritimis (*Plantago maritima*?).

a. England. Presented by F. Walker, Esq."

It is necessary to make the following comments on the foregoing descriptions:—

(*a*) In the description of the genus, Haliday lays stress upon the *absence* of a terminal style to the antenna. Lindeman (1886), Uzel (1895) and some more recent authors disregard this important point. Priesner, in his Monograph (1926–28), puts the matter right as far as his "nominatform" *rufus* is concerned, but includes *A. stylifer* Tryb. as a form of *A. rufus* Gmel.

The question of raising a new genus to contain those species the imaginal antennae of which possess a terminal style, is disposed of as undesirable in the introduction to this paper.

(*b*) Accompanying the description of 1852 are pencil drawings on Pl. V, figs. 5–8, representing the larval and pupal stages, fig. 11 the female imago, in the latter of which the antenna is clearly indicated as being devoid of a terminal style. In figs. 9 and 10 the male is depicted, and in consonance with the description, only one pair of thorn-like setae appear upon the 9th abdominal tergite. Haliday evidently failed to detect the second and much smaller posterior pair which are probably present in all the species of this genus.

3. *Description.*

The following description of the imagines of *A. rufus* (Gmel.) Hal., applies *in toto* to all the other known species of the genus (except *A. melanophthalmus* Bagnall) save for those portions printed in italics, or otherwise denoted.

Female Imago.

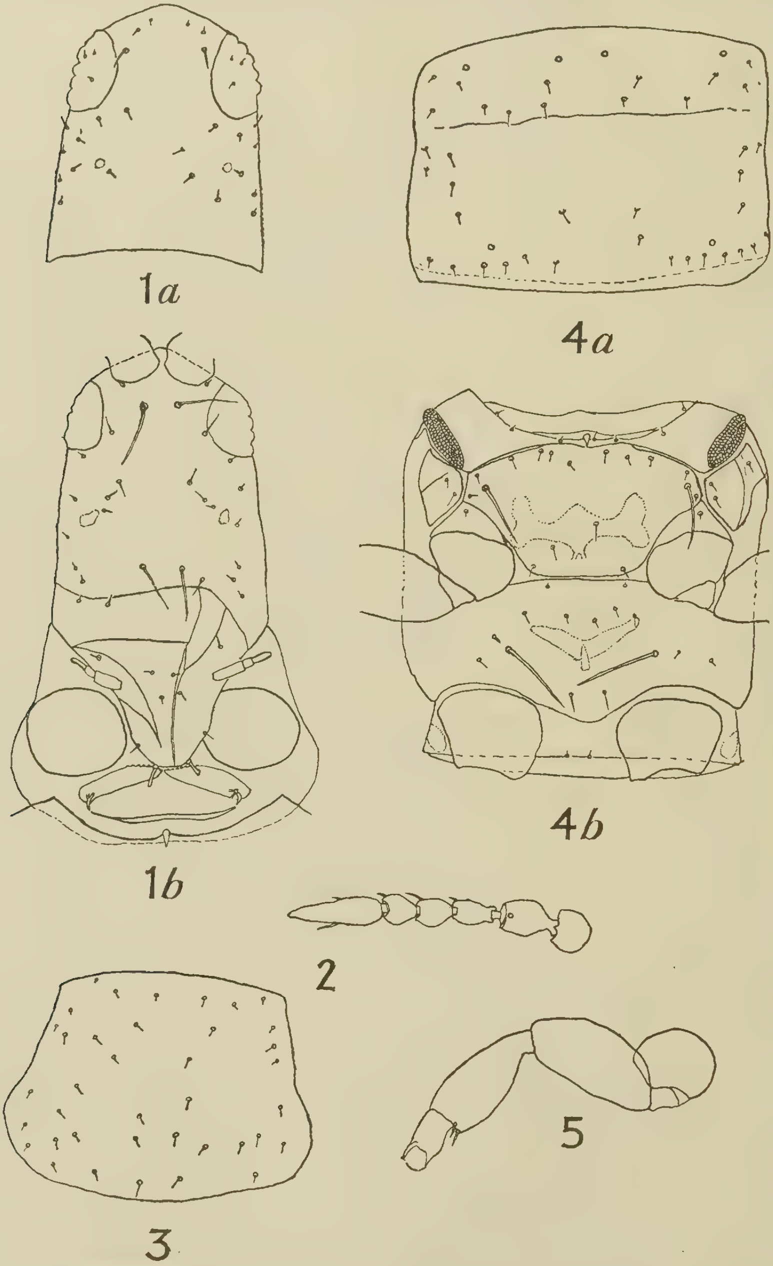
Length about 1·2 mm. Width of mesothorax about 0·2 mm.

General colour yellow, shaded with yellowish brown, *deepening to rich or dusky brown in specimens collected upon halophytic plants.* Eyes black. Shape slender and fusiform. Wings entirely absent. The integument entirely devoid of pubescence, lightly reticulate except at the sutures of the thoracic and abdominal segments, where it is foveolate. Setae fine and mostly very short: of moderate length only upon the frons, ventral surface of the pterothorax * and 9th abdominal segment, and on the 9th and 10th abdominal tergites. The 10th abdominal tergite is split longitudinally. Stigmata placed, as in many other Terebrantia, at the anterior angles of the pterothorax, at the lateral margins of the 1st and of the 8th abdominal segments. The stigmatal plates of the pterothorax are large and elliptic, of the first abdominal segment smaller and sub-triangular, of the eighth small and oval. *The head.* About 1·2 times longer than broad, the sides behind the eyes nearly parallel. Eyes relatively small, hardly protruding over the lateral margins. Ocelli absent. Chaetotaxy:—Dorsal aspect. The inconspicuous setae arranged as in fig. 1 *a*. Ventral aspect. The inconspicuous setae arranged as in fig. 1 *b*. Between the eyes a pair of moderately long fine setae, and a similar rather shorter pair near the frontal suture. *Maxillary palpi* composed of 3 joints, the proximal much longer than either of the two distal joints. *Labial palpi* composed of 2 joints, the proximal extremely short. *Mouth-cone* extending between the coxae of the prothoracic legs, its apex in line with their hind margins. *Antennae* short, *composed of* 6 *joints.* The joints, viewed from above, are of the following shapes: 1, roughly semicircular: 2, *like an inverted flask, the basal neck short and not very narrow*: 3, with a narrow basal peduncle, the distal main portion strongly flanged proximally: 4 and 5 like inverted flasks with narrow basal necks, the inner margins more rounded than the outer: 6, lanceolate, with narrow basal neck expanding sharply. The integument of joints 2–6 is broadly annulate, the annulations upon joint 6 sparsely beset with microsetulae. Upon these joints are irregular whorls of few and short setae. Upon joint 2, a dorsal circular sensorium near the distal margin. Upon the outer margins of joints 3 and 4, in the distal third, a single slightly curved simple trichome: a short trichome placed similarly upon the 5th joint. Joint 6 with a very short trichome upon the outer margin, about the middle of the joint, and a much longer trichome opposite to it upon the inner margin, *the latter not reaching nearly to the apex of the joint.* (These trichomes are not easy to distinguish from the setae in their vicinity.) *The prothorax.* Broadly urceolate. Devoid entirely of conspicuous setae. The inconspicuous setae of the dorsal surface arranged as in fig. 3. The ventral surface devoid of setae. *The pterothorax.* Quadrangular, rather broader than long. Dorsal surface with an anteriorly placed transverse row of 4 seta-pits, and a seta-pit on each side placed laterally near the posterior margin. The inconspicuous setae arranged as in fig. 4 *a*. Ventral surface with a moderately long seta on each side near the lateral margin of the mesothoracic sternum: a similar pair of setae lies upon the posterior face of the metathoracic sternum. The inconspicuous setae arranged as in fig. 4 *b*. *The legs.* Short, very stout; devoid of specially modified setae. At the distal extremity of the tibiae of the metathoracic legs only, one or two setae tend to be spine-like. *The abdomen.* Long, slender, cylindrical, tapering gradually behind the 8th segment. The tergites strongly bent round laterally. 1st and 2nd segments devoid of epipleurites, the 1st also of

---

* Though wings are absent, this term is used for convenience to denote the region of the body comprised of the meso- and metathorax.

pleurites. Epipleurites of 3rd to 7th segments very narrow, reticulate. Pleurite of 2nd segment very narrow; pleurites of the 3rd to 7th segments well developed, reticulate except at their posterior extremities, which are clear and end in an irregularly denticulate margin.

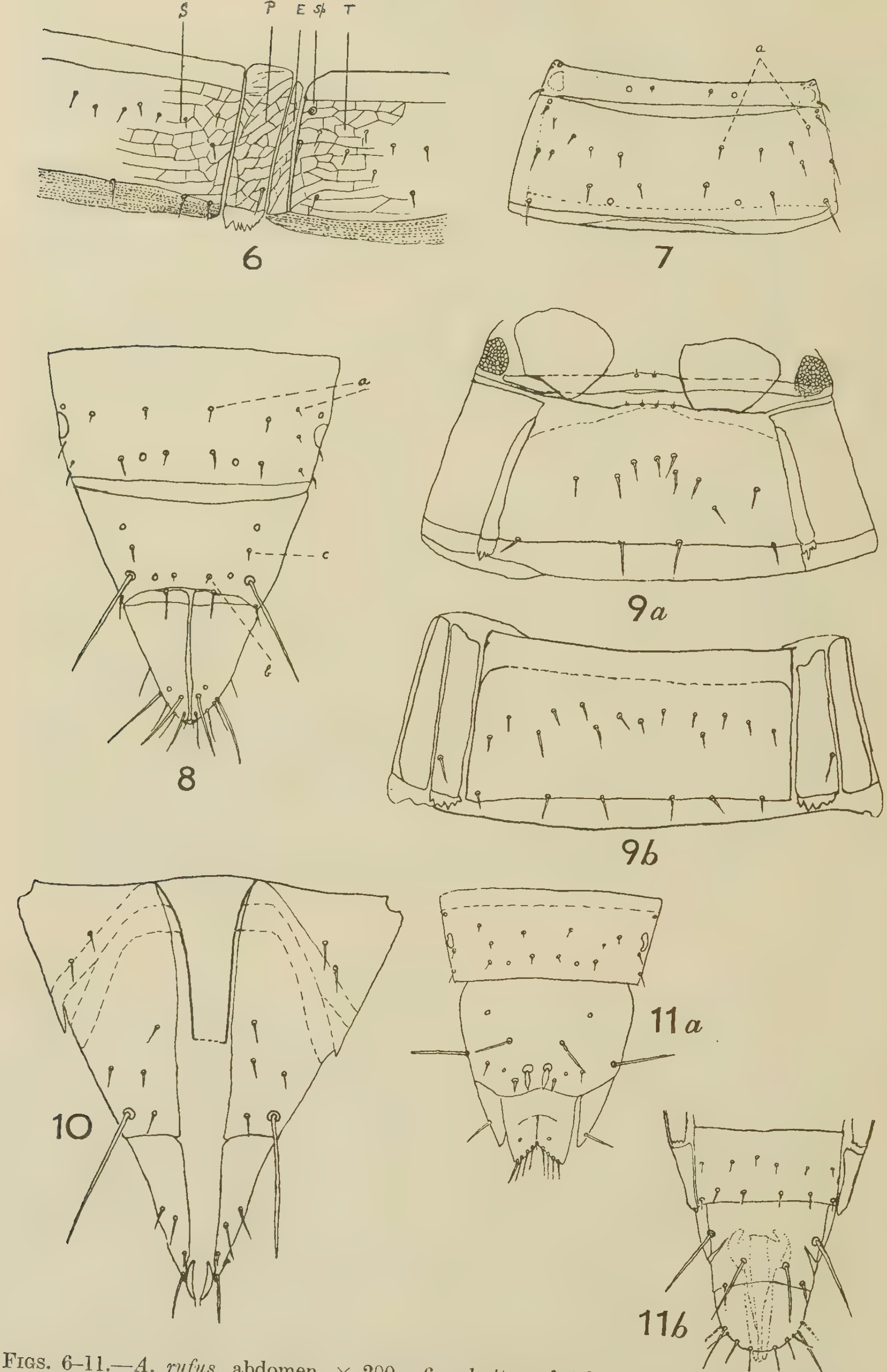


Figs. 1–5.—*Aptinothrips rufus* ♀, × 200, 1 *a*, chaetotaxy of head, dorsal aspect, 1 *b*, of head and prothorax, ventral aspect; 2, outline of antenna; 3, chaetotaxy of prothorax, dorsal aspect; 4 *a*, of pterothorax, dorsal aspect, 4 *b*, of pterothorax and 1st abdominal segment, ventral aspect; 5, outline of metathoracic leg, from above.

They lie at right angles or even at an acute angle to the adjoining epipleurites. Sternites very slightly convex. Chaetotaxy:—The posterior margins of the segments or their component sclerites are entirely devoid of fringes of setae. Tergite 1. A very short seta on each side of the median line, posterior to which, and more laterally placed, is a seta-pit on each side. At each anterior lateral angle a seta-pit, in the neighbourhood of which lie 2 or 3 minute setae. At the posterior angles, near the stigmatal plate, a short seta on each side. Tergite 2. *Across the anterior and median regions, an irregular transverse row of at least* 4 *to as many as* 20 *short setae* (figs. 7 and 8 at (*a*)). Across the posterior region a transverse row of 4 (not the same number in all species of the genus) short setae, posterior to which lies a pair of seta-pits. At the anterior lateral angles, a seta-pit on each side, and along the lateral margins two short setae. Tergites 3–8 inclusive as tergite 2. Additional very short setae may occur near the lateral margins of the 8th tergite. Tergite 9. The anterior region with a laterally placed seta-pit on each side. The median region with a laterally placed short seta on each side (fig. 8 at (*c*)). The posterior region with a median pair of *very short* setae (fig. 8 at (*b*)), to either side of which lies a seta-pit. Lateral to these lies a long seta to each side. A rather short very fine seta is placed upon the posterior margin of the tergite on each side. A short seta lies at the posterior lateral angle on each side. Tergite 10. In the posterior region, a seta-pit on each side of the median line: closely posterior to these, a transverse row of 4 moderately long setae. Across the posterior margin, a row of six shorter setae. Two minute setae are placed upon the 11th segment. The epipleurites are devoid of setae. The pleurites (see figs. 6 and 9). Those of the 2nd abdominal segment are devoid of setae. On each of those following, a single rather short seta is situated towards the posterior region near the lateral margin adjoining the epipleurite. Sternite 1. 2 minute setae at the anterior margin. Sternite 2. 2–6 minute setae at the anterior margin. A few short intermarginal setae upon the surface. A transverse row of 4 short setae across the posterior margin. Sternites 3–7. Upon the surface of each, irregular rows of short intermarginal setae. A transverse row of 6 short setae across the posterior margin of each. Sternite 7 has a small seta-pit on each side, placed laterally in the anterior region. 8th, 9th, and 10th abdominal segments. Ventral surface. The inconspicuous setae arranged as in fig. 10, but subject to some variation in number and position. At the posterior lateral angles of the 9th segment, a long seta on each side.

Male Imago.

About three-quarters the size of the female: lighter in colour. Except for the 8th, 9th, and 10th abdominal segments, similar in structure to the female. The sternite of the 8th abdominal segment similar to those of the 3rd to 7th segments: the pleurite devoid of setae: the epipleurite not present. Abdominal sternites entirely devoid of translucent depressions. 9th Abdominal Segment. Dorsal surface. Anterior region with a laterally-placed seta-pit on each side. Median region with a pair of moderately long, fine, setae. Posterior region with a median pair of short but very conspicuous stout lanceolate setae: lateral to these lies a seta-pit on each side. At the posterior margin a second pair of finer spine-like setae. The lateral margins on each side with a long fine seta, and a shorter seta at each posterior angle. Ventral surface. In the median region, a long seta on each side, placed laterally: in the posterior region a shorter seta on each side of the median line: at the posterior lateral angle, a short seta on each side. 10th abdominal segment. Dorsal surface. Upon each lateral lobe, a short seta. In the posterior region, a pair of seta-pits posterior to which lies a minute seta in the median line. The oblique posterior margin of each side beset with a row of 4 setae. Ventral surface. The posterior rounded margins beset with 4 short setae.



Figs. 6–11.—*A. rufus*, abdomen, × 200. 6, sclerites of 4th segment. E. Epipleurite, P. Pleurite, S. Part of Sternite, Sp. Seta-pit, T. Part of Tergite; 7, ♀ (dark form), chaetotaxy of 1st and 2nd tergites; 8, ♀, chaetotaxy of 8th, 9th, 10th (and 11th) tergites; 9 *a*, of 1st and 2nd segments, ventral aspect; 9 *b*, of 3rd segment, ventral aspect; 10, of 8th, 9th, and 10th segments, ventral aspect (the ovipositor is not shown); 11, ♂, chaetotaxy of 8th, 9th, and 10th segments, *a*, (dark form) dorsal aspect, *b*, (light form) ventral aspect.

II. STRUCTURAL CHARACTERISTICS OF THE GENUS.

From the foregoing account of the type species and from a comparison with it of the other known species which with certainty are referable to this genus, the following characteristics are presented as a possible diagnostic guide by means of which the genus may be separated from other genera of Thysanoptera.

Aptinothrips Haliday.

Slender elongate insects. The integument of the main divisions of the body lightly reticulate and entirely devoid of *microsetulae*, which, in certain other genera constitute, to a greater or less degree, what is known as " pubescence." *Head.* Longer than broad : the sides, posterior to the eyes, almost parallel. In dorsal aspect, devoid of conspicuous setae. Eyes small, with few facets. Ocelli absent. Antennal joints 3–6 inclusive bearing simple trichomes. 3rd joint flanged proximally (*i.e.* immediately distal to the narrow basal neck) : 4th and 5th joints shaped like inverted flasks with narrow necks. Mouth-cone extending to the posterior margin of the prothoracic coxae. Maxillary palpi 3-jointed. Labial palpi 2-jointed. *Prothorax* beset only with inconspicuous setae. *Pterothorax* devoid entirely of wings. Dorsally a transverse row of 4 seta-pits near the anterior margin : one pair of seta-pits near the posterior margin, in addition to the inconspicuous setae. *Legs* unusually short and stout, devoid of modified setae. *Abdomen* cylindrical, the sides almost parallel to the 8th segment. The sclerites of each segment entirely devoid of fringes of setae across their posterior margins. Tergites 1–8 inclusive beset with inconspicuous setae : a pair of seta-pits near the posterior margin of each. Epipleurites narrow and devoid of setae. Pleurites reticulate except in the posterior region of each : their posterior margins irregularly denticulate : the outer margins of each beset with a short seta in the posterior region. Sternites 1 and 2 beset at their anterior margins with minute setae. 2 to 7 (8 in the male) inclusive beset with irregular rows of intermarginal setae. *Male.* Sternites devoid of translucent depressions. 9th abdominal tergite : in the anterior region a pair of seta-pits : in the median region a pair of moderately long fine setae : in the posterior region a pair of seta-pits, and two pairs of short modified setae, one pair lying anterior to the smaller posterior pair.

III. THE SPECIES OF THE GENUS *APTINOTHRIPS* HALIDAY.

(a) *Preliminary remarks.*

As far as it has been possible to ascertain, the following have been described as species or varieties in the genus *Aptinothrips* :—

A. rufus (Gmelin) Haliday. *A. nitidulus* Haliday.
A. elegans Priesner. *A. rufus* var. *mediterranea* Priesner.
A. stylifer Trybom.
A. karnyi John. *A. rufus* forma *styligera* Priesner.
A. melanophthalmus Bagnall.

On structural similarity, it would appear that *A. rufus* (Gmel.) Hal., and *A. nitidulus* Hal., should be treated as one and the same species : the relationship between the two has been explained in the introduction. No structural distinction, which is here considered valid, can be found between *A. elegans* Pr. and Priesner's var. *mediterranea.* It has not been possible to examine specimens of Priesner's form *styligera* : from the figure of the antenna (Priesner 1926–28, fig. 41) the latter might possibly be identical with the more recently described *A. karnyi* John.

The apparently valid species, as at present known, are therefore five in number, but of these *A. melanophthalmus* Bagnall is probably referable to some other genus of the Terebrantia : only the type specimen exists and from it the structural characteristics are not easily determined. For the present, however, it is considered best to retain the insect in the genus *Aptinothrips* until further material is available.

(b) *Characters for the separation of the Imagines.*

All the known species which are certainly referable to the genus *Aptinothrips* resemble one another very closely in size, shape, and colour. In their chaetotaxy they resemble one another almost exactly as far as the head, prothorax, pterothorax and 1st abdominal segment are concerned. Constant differences in the chaetotaxy, which serve as reliable diagnostic characters, are confined to the 2nd to 9th abdominal tergites in the female, and 2nd to 8th abdominal tergites in the male sex, and, in the case of *A. elegans* Priesner to the posterior margins of each of the 2nd to 7th abdominal sternites inclusive.

Generally speaking, these structural differences would appear to be extremely insignificant, especially as the majority of them cannot easily be observed in specimens which have not been treated with potassium hydroxide before mounting. It should be pointed out, however, that the differences in the chaetotaxy which serve to separate any given species from others are repeated on each of the 2nd to 8th abdominal segments, and as far as is possible, these differences have been proved to be constant, and are often correlated with other diagnostic characteristics.

Though the presence or absence of the antennal style is also a constant diagnostic character, the shape of the several antennal joints which constitute the main portion of the antenna presents a difficult problem.

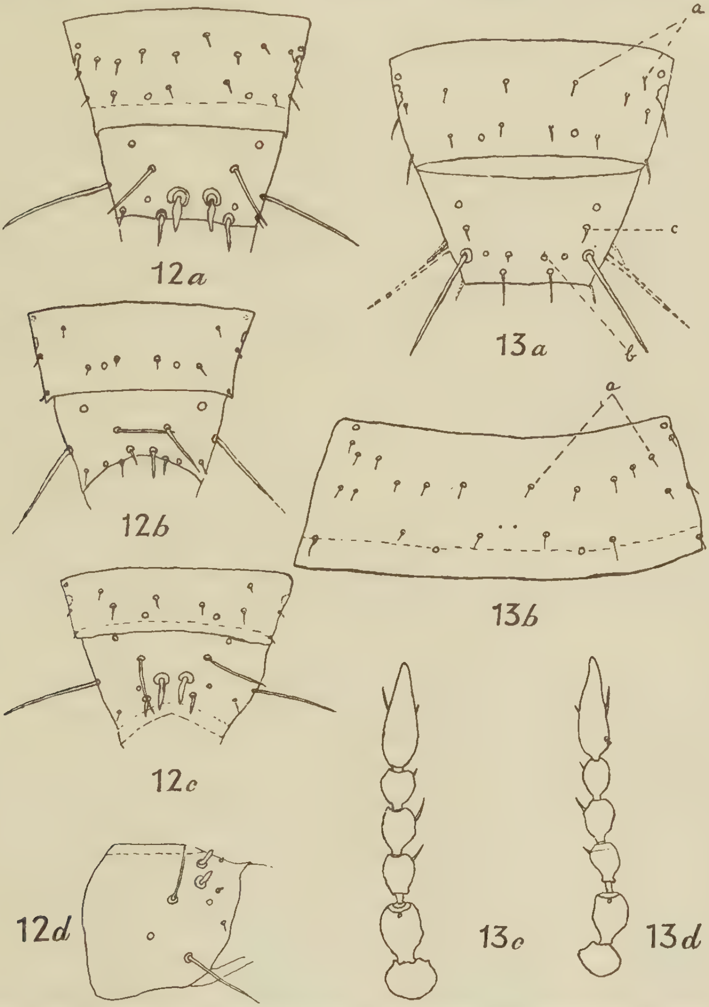
The shape of the 2nd antennal joint, and to a lesser extent the first, would appear to be very highly characteristic in the species *A. elegans* Priesner, when compared with what, for convenience' sake, may be termed the " unmodified " shape of these joints in *A. rufus* (Gmel.) Hal. and *A. stylifer* Tryb.

When examining large numbers of specimens of the two latter species, however, there sometimes occurs, in the species *A. rufus* at any rate, some approach towards the " modified " shape of these joints usually characteristic of *A. elegans*, but the differences between all three species with reference to the abdominal chaetotaxy remains constant.

Now Priesner's var. *mediterranea* in both sexes shows a transitional state between the " modified " and the " unmodified " condition, retaining all the characteristics of the abdominal chaetotaxy which serve to separate *A. elegans* Pr. from all the other known species of the genus. Further, the trichomes upon the antennal joints of the male *A. elegans* and var. *mediterranea* are markedly longer than those of the other species. It is for these reasons that it has been decided here to treat *A. elegans* and the var. *mediterranea* as one and the same species.

It would appear, therefore, that the shape of the antennal joints is not quite constant within the species, but at the same time it cannot be entirely disregarded. To surmount the difficulty, it is considered best, after the diagnostic characters have been enumerated for each species, to make reference to the shape of the antennal joints and to give outline drawings of the antennae according to the form which they *usually* assume in each species.

The unlikelihood of the " unstyled " type of antenna arising, through variation within the species, from the " styled " type has been dealt with in the introduction (p. 485). Figs. 11 *a* and 12 *a*, *b*, *c* and *d* represent the chaetotaxy of the *male* 8th and 9th abdominal tergites of three species of the genus. Owing to the difficulty of obtaining males, the variation in dimension of setae upon the 9th abdominal tergite, especially those of thorn-like form, has only been studied in the species *A. rufus* (Gmel.) Hal. In the latter the variation is *very considerable*, and as no essential differences in the chaetotaxy of this tergite are discernible between *A. rufus* and *A. stylifer* Tryb. it is concluded that the 9th abdominal tergite of the male presents no characters of diagnostic value between the species. From the illustrations, however, it will readily be seen that the chaetotaxy of the 8th abdominal tergite differs in *A. rufus* (Gmel.)



FIGS. 12–13.—12, *Aptinothrips* ♂, chaetotaxy of 8th and 9th abdominal tergites, × 200, *a*, *A. rufus* (light form), *b*, *A. elegans* (from var. *mediterranea* Priesner), *c*, *A. stylifer*, *d*, *A. elegans*, 9th tergite only (side view from allotype). 13, *Aptinothrips*—diagnostic characters for the species—× 200; *A. rufus*, *a*, ♀, 8th and 9th abdominal tergites, *b*, ♀, 2nd abdominal tergite, *c*, ♀ (dark form), outline of antenna, *d*, ♂, outline of antenna. See also 14 *c*.

Hal. from the other species, a similar difference occurring upon each of the six preceding tergites and being similarly represented in the female imago.

(c) *Diagnostic Characters for the Imagines.*

Note.—The abdominal setae are only clearly visible in specimens treated with potassium hydroxide and mounted in Faure's medium. A magnification of 300 diameters or more is required for their observance.

1. *Aptinothrips rufus* (Gmelin) Haliday.

For Synonymy *see* p. 486.

Female (fig. 13 *a–c*).

i. 9th Abdominal Tergite (13 *a*: see also fig. 8). The pair of setae at (*c*) in the median portion, very short. The median pair of setae at (*b*) in the posterior portion, very short, placed in line with the posterior pair of seta-pits and the long lateral pair of setae, all these lying anterior to the fine pair of setae upon the posterior margin.

ii. 2nd to 8th Abdominal Tergites (13 *b* and 13 *a*: see also figs. 7 and 8). Upon each tergite, in the anterior and median portions, an irregular transverse row of short setae at (*a*) from 4 to 20 or more in number: in the posterior portion, a transverse row of 4 setae (these exclusive of the seta placed upon the extreme lateral margin of each side) lying anterior to the pair of seta-pits near the posterior margin.

iii. 3rd to 6th Abdominal Sternites (fig. 14 *c*). The transverse row of 6 setae across the posterior margin of each sternite in line.

iv. Antennae (13 *c*. See also fig. 2). Composed of 6 joints without a terminal style: trichomes short.

Male (fig. 13 *d*).

ii, iii and iv, as in the female. *Antennae* (13 *c* and 13 *d*). Alike in both sexes. Usual shape of the joints in outline:—1, roughly semicircular, the sides convex distally: 2, like an inverted flask, with the neck short, and rather broad: 5, the sides evenly rounded.

2. *Aptinothrips elegans* Priesner.

elegans Priesner, 1924, *SitzB. Akad. Wiss. Wien*, **133**: 528.
elegans Priesner, 1926–28, *Thysanopt. Europ.*: 161–2, pl. iii, fig. 37.
rufus var. *mediterranea* Priesner, 1926–28, *loc. cit.*: 159–160, pl. iii, fig. 39.

Female (fig. 14 *a*, *b*, *d*).

i. 9th Abdominal Tergite (14 *a*). The pair of setae at (*c*) in the median portion very short. The median pair of setae at (*b*) in the posterior portion very short, placed in line (together with the adjacent pair of seta-pits) with the fine pair of setae upon the posterior margin.

ii. 2nd to 8th Abdominal Tergites (14 *a*). Upon each tergite, either in the anterior or median portion, one pair of setae only: in the posterior portion, a transverse row of 4 setae (these exclusive of the seta placed upon the extreme lateral margin of each side) lying anterior to the pair of seta-pits near the posterior margin.

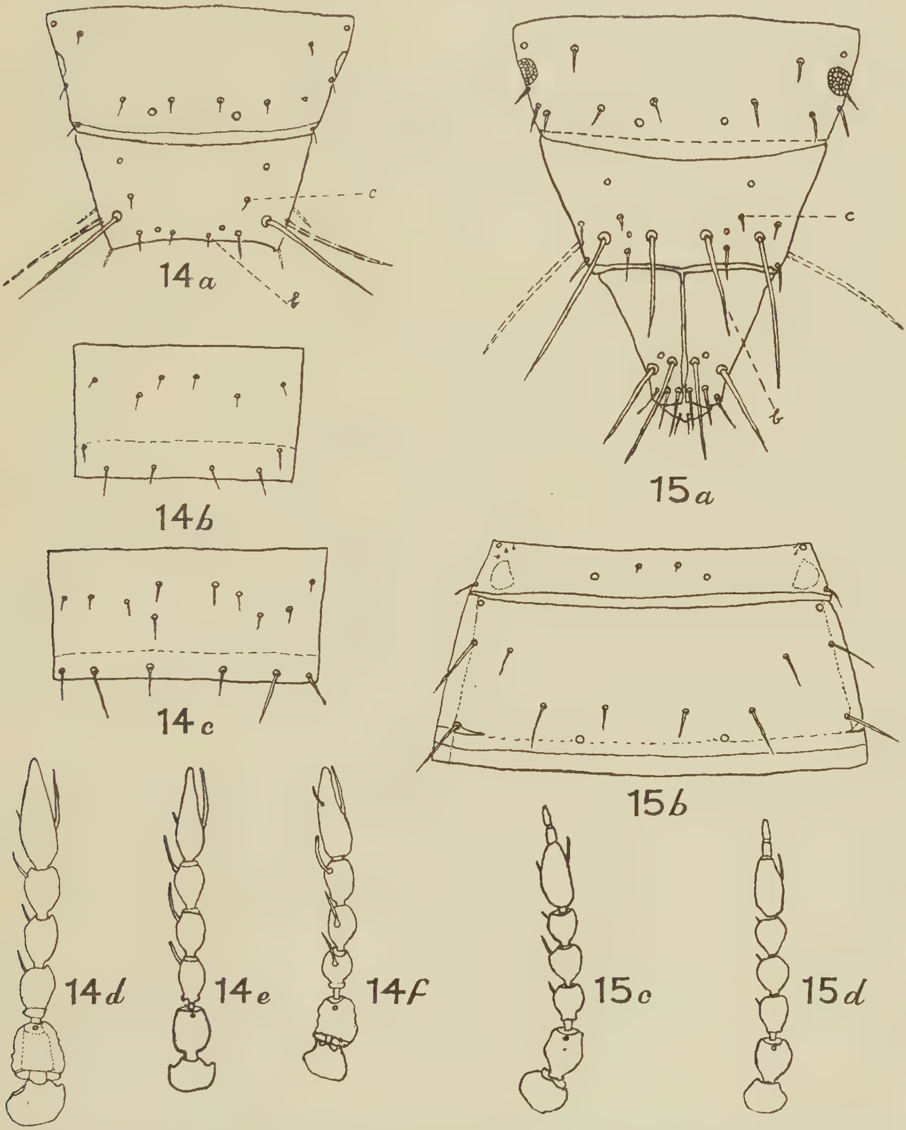
iii. 3rd to 6th Abdominal Sternites (14 *b*). The transverse row of 6 setae across the posterior margin of each sternite *not* in line: the most lateral seta of each side is placed far anterior to the four inner setae, cf. *A. rufus* (14 *c*).

iv. Antennae (14 *d*). Composed of 6 joints without a terminal style: trichomes short.

Male (fig. 14 *e* and *f*).

ii and iii as in the female. Antennal trichomes long, that upon the inner margin of the 6th joint reaching to the apex of the joint. *Antennae* (14 *d* and 14 *f*). Shape of the joints alike in both sexes: the trichomes of the male much longer than those of the female. Usual shape of the joints in outline:—1, roughly semicircular; the sides strongly concave distally: 2, the proximal neck short and narrow; the main portion very broad, folded back over the neck, the sides slightly convergent towards the apex: 5, the sides parallel or only slightly rounded.

In Priesner's var. *mediterranea* (14 *e*) the sides of joint 1 are less strongly concave distally, joint 2 is broadest in the median region of the main portion, the latter not being folded backwards over the proximal neck: joint 5, the sides are more rounded.



FIGS. 14–15.—*Aptinothrips*—diagnostic characters for the species—× 200; 14, *A. elegans*, *a*, ♀, 8th and 9th abdominal tergites, *b*, ♀, 6th abdominal sternite, *d*, ♀, outline of antenna, *e*, ♂, outline of antenna (from var. *mediterranea* Pr.), *f*, ♂, the same (from the allotype), *c*, *A. rufus*, ♀, 6th abdominal sternite (for comparison with *b*); 15, *A. stylifer*, *a*, ♀, 8th, 9th, 10th (and 11th) abdominal tergites, *b*, ♀, 1st and 2nd abdominal tergites, *c*, ♀, outline of antenna, *d*, ♂, the same.

3. *Aptinothrips stylifer* Trybom.

rufa Lindeman, 1886, *Bull. Soc. imp. Nat. Moscow*, **62** (2) : 319–320, fig. 11.
stylifera Trybom, 1894, *Ent. Tidskr.*, **15** : 41–58.
rufus Uzel, 1895, *Mon. Thysanopt.* : 152–4 (? pl. ii, fig. 17), pl. vi, fig. 78.
rufus Hinds, 1902, *Proc. U.S. Nat. Mus.*, **26** : 167, pl. v, fig. 53.
form *stylifera* Priesner, 1926–28, *Thysanopt. Europ.* : 158–9, pl. iii, fig. 40.
form *stylifera* Sharga, 1933, *Ann. appl. Biol.*, **20** : 308–326.

Female (fig. 15).

i. 9th Abdominal Tergite (15 *a*). The pair of setae at (*c*) in the median portion short. The median pair of setae at (*b*) in the posterior portion *long* and rather stout.

ii. 2nd to 8th Abdominal Tergites (15 *b* and 15 *a*). Upon each tergite, either in the anterior or median portion, one pair of setae only : in the posterior portion, a transverse row of **4** setae (these exclusive of the seta placed upon the extreme lateral margin of each side) lying anterior to the pair of seta-pits near the posterior margin.

iii. Antennae (15 *c*). Composed of 8 joints, the two narrow distal joints forming a style. Trichomes short.

Male (fig. 15 *d*).

ii and iii as in the female. *Antennae* (15 *c* and 15 *d*). Usual shape of the joints in outline :—1, roughly semicircular, the sides convex distally : 2, like an inverted flask, with the neck short, and rather broad : 5, the sides evenly rounded.

4. *Aptinothrips karnyi* John.

? form *styligera* Priesner, 1926–28, *Thysanopt. Europ.* : 159, pl. iii, fig. 41.
karnyi John, 1927, *Bull. Ann. Soc. ent. Belg.*, **67** : 205–7, figs. 1 and 2.

Female (fig. 16).

i. 9th Abdominal Tergite (16 *a*). The pair of setae at (*c*) in the median portion short. The median pair of setae at (*b*) in the posterior portion *long* and rather stout.

ii. 2nd to 8th Abdominal Tergites (16 *a*). Upon each tergite, either in the anterior or median portion, one pair of setae only : in the posterior portion, a transverse row of **6** setae (these exclusive of the seta placed upon the extreme lateral margin of each side) lying anterior to the pair of seta-pits near the posterior margin.

iii. Antennae (16 *b* and 16 *c*). Composed of 8 joints, the two rather broad distal joints forming a style : trichomes short.

Male not known.

Antennae (16 *b*). Usual shape of the joints in outline :—1, roughly semicircular, the sides concave distally : 2, like an inverted pear ; the proximal neck long and narrow (viewed from above), the main portion much swollen in the middle region : 5, the sides evenly rounded.

5. *Aptinothrips* (?) *melanophthalmus* Bagnall.

melanophthalmus Bagnall, 1927, *Ent. Mon. Mag.*, (9) **20** : 567.

Female (fig. 17).

From the single type specimen in the British Museum (Natural History).

i. 9th Abdominal Tergite (17 *a*). The pair of setae at (*c*) in the median portion comparatively long : the posterior pair of seta-pits lie *anterior* to these setae. The median pair of setae at (*b*) in the posterior region very long and fine.

ii. 2nd to 8th Abdominal Tergites (17 *b*). Upon each tergite, there appears to be an absence of setae in the anterior and median portions : in the posterior portion, a transverse row of **8** setae (these exclusive of the seta placed upon the extreme lateral margin of each side) lying *posterior* to (or in line with) the median pair of seta-pits.

iii. Antennae (17 *c*). Composed of 6 joints, without a terminal style. Shape of joints in outline :—1, roughly semicircular, the sides convex distally : 2, roughly quadrate, the proximal portion not very much narrower than the distal : 5, the sides almost parallel.

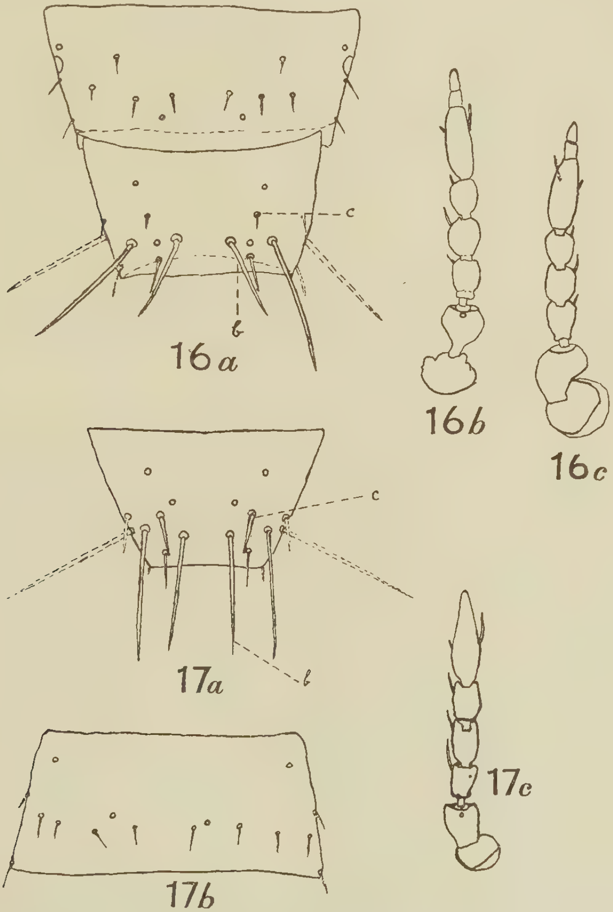
In his description, Dr. R. S. Bagnall (*loc. cit.*) compared the specimen to other species of the genus *Aptinothrips*, as follows :—

"Head longer than the pronotum and at least 1·25 times as long as broad across the eyes; sides more or less sub-parallel; eyes not prominent, occupying 0·3 to 0·35 the dorsal length of the head. Legs short and stout.

Apical abdominal setae shorter. *A. rufus* Hal., *elegans* Pr. and *nitidulus* Hal.

Head shorter than the pronotum and approximately as broad across the eyes as long: cheeks narrowed behind the eyes, which are large and prominent, occupying more than 0·5 the dorsal length of head. Legs noticeably longer and more slender.

Apical abdominal setae longer . . . . *A. melanophthalmus*."



FIGS. 16–17.—*Aptinothrips*—diagnostic characters for the species—× 200; 16, *A. karnyi* ♀, *a*, 8th and 9th abdominal tergites, *b*, outline of antenna from above, *c*, from the side; 17, *A.* (?) *melanophthalmus* ♀, *a*, 9th abdominal tergite (reconstructed), *b*, 2nd abdominal tergite, *c*, outline of antenna.

In addition to these characters, and the different arrangement of setae upon the abdominal tergites, another characteristic which would appear to separate this insect from all other species and therefore from the genus *Aptinothrips*, is the presence, between the eyes, of a pair of setae of considerable length.

(d) *Tabular Key to the Imagines* (excluding *A. melanophthalmus* Bagn.).

	rufus Hal.	*elegans* Pr.	*stylifer* Tryb.	*karnyi* John.
Antennae.				
6-jointed	×	×		
8-jointed			×	×
9th Abdominal Tergite (*Female only*).				
Posterior median setae very short	×	×		
Posterior median setae long			×	×
Posterior median setae and seta-pits in line with long lateral setae	×		×	×
Posterior median setae and seta-pits near the posterior margin		×		
2nd to 8th Abdominal Tergites (inclusive).				
One pair of setae upon anterior dorsal face of each * . .		×	×	×
4 to 20 or more setae upon anterior dorsal face of each . .	×			
Number of setae in transverse row across posterior face of each *	4	4	4	6
2nd to 6th Abdominal Sternites (inclusive).				
Posterior marginal setae of each in line	×		×	×
Outer posterior marginal setae of each lie anterior to the inner setae		×		
Antennal Trichomes (*Male only*).				
Short	×		×	×
Long		×		

* Exclusive of setae on the extreme lateral margins and of seta-pits. It should be remembered that under *A. rufus* (Gmel.) Hal. is included Haliday's *A. nitidulus*, and under *A. elegans* Pr., Priesner's var. *mediterranea*.

(e) *Variation and aberration.*

In the two species *A. rufus* (Gmel.) Hal. and *A. stylifer* Tryb. of which it has been possible to examine large numbers of specimens, only in the latter species has any variation, and that insignificant, been encountered in the diagnostic characters set out in the last two sections. In this species, upon one or other of the abdominal tergites 2 to 8 inclusive, one seta of the pair in the more anterior portion of the tergite is very occasionally duplicated. In both species upon one or other of the abdominal tergites, a seta-pit may occasionally be duplicated on one side of the segment. These variations, common in other Thysanoptera, have no significance, and show no approach from one species towards another. Variation within the species in the shape of the several antennal joints has been dealt with in Section III (b): it may be added here that occasionally the 5th antennal joint of *A. elegans* Pr. has the sides rounded in the antenna of one side, and nearly parallel in that of the other in the same individual.

While the antennae of *A. stylifer* Tryb. do not appear often to be subject to aberration, deformities of those of *A. rufus* (Gmel.) Hal. are very frequent, and usually take the form of a complete absence of the 5th or of both the 4th and 5th joints. The deformity usually occurs in the one or other antenna of a single specimen, but both antennae are sometimes affected (fig. 18 *a*). Similar aberrations occur, probably frequently, in *A. elegans* Priesner.

In *A. rufus*, malformed individual joints sometimes show areas of considerable size which bear some resemblance to sensoria found in other groups of Thysanoptera. A malformed 6th joint of one specimen examined has a division at its distal extremity, the nature of which illustrates the unlikelihood, rather than otherwise, of the "un-styled" antenna being convertible by direct variation to the "styled" antenna in this genus (fig. 18 *b*).

IV. HABITAT AND DISTRIBUTION OF THE SPECIES.

1. *Aptinothrips rufus* (Gmel.) Haliday.

The common light-coloured form lives upon grasses, especially when these grow luxuriantly, in meadows, and is to be found at all times of year. Dr. G. Morison has recorded it most abundantly from grasses of the genera *Agropyron*, *Agrostis*, *Aira*, *Anthoxanthum*, *Dactylis*, *Elymus*, *Hordeum*, *Panicum* and *Poa*: less so from *Arrenatherum*, *Arundo*, *Brachypodium*, *Carex*, *Digraphis*, *Festuca*, *Holcus*, *Juncus*, *Lolium*, and *Psamma*.

Apart from grasses, including barley, etc., the only records to hand are :—

Chrysanthemum : Caterham, Surrey. R. S. Bagnall, July 1924.
Euphorbia : Bolzano, Italy. R. S. Bagnall, Sept. 1929.
Hieraceum : L'Hospitalet, E. Pyrenees. R. S. Bagnall, Sept. 1929.
Lathyrus : Zurich, Switzerland. R. S. Bagnall, July 1925.
Tea-flowers : Lebang, Darjeeling, Bengal, India. H. M. Lefroy, Feb. 1909. (one ♀).

The distribution of this form is extremely wide. It is common probably throughout Europe and North America : the record from India has already been cited, and amongst specimens of *Chirothrips manicatus* Hal. and *Limothrips cerealium* Hal., kindly collected from grass at Lincoln, New Zealand, by Mr. G. A. H. Helson in 1934, is a 1st instar larva certainly referable to the genus *Aptinothrips*, and almost certainly to the species *rufus*. The insect occurs from sea-level to high altitudes, having been collected by Dr. R. S. Bagnall in the Eastern Pyrenees at an elevation of 6000 ft. The dark form, named *nitidulus* by Haliday, appears to be confined to plants, growing on the sea-coast, which are actually inundated by sea-water at high tide, or to halophytic plants growing in salt marshes, but, as Dr. Priesner and Dr. Morison point out, it does not necessarily occur in localities where one would expect to find it.

As the relationship between the two forms is of considerable interest, and still by no means clear, it is well to give a list of localities in which the dark form has been collected.

S. England : Clovelly, N. Devon, August 1913, R. S. Bagnall. Dawlish, S. Devon, June 1928, R. S. Bagnall. Hamble, Southampton, September 1911, C. B. Williams. Rye, Sussex, June 1930, G. D. Morison. Winchelsea, Sussex, June 1930, G. D. Morison. *N.W. England :* Hightown, Lancashire, September 1924, R. S. Bagnall. *N.E. England :* Warkworth, Northumberland, July–September 1924, R. S. Bagnall. *S.W. Scotland :* Isles of Arran and Bute, July 1907, R. S. Bagnall. *N.E. Scotland :* Newburgh, Aberdeenshire, Feb. April 1928, Aug. 1927, G. D. Morison. Cullen, Banffshire, August 1932, G. D. Morison. Portmahomack, Ross-shire, May 1931, G. D. Morison. *N.W. Scotland :* Fort William, August 1928, R. S. Bagnall. *E. Ireland :* Portmarnock, Dublin, R. S. Bagnall. *S.W. France :* Arcachon, Bayonne, August 1926, R. S. Bagnall.

In all cases where dates are given, there is, amongst the specimens, a mixture of dark and light forms, nearly always with gradations of colour between the two. Two specimens from *Juncus* at Arcachon are exceptionally dark, the others being quite light. Throughout, the young stages show a reddish tint, often, however, very slight. Males are recorded from Hightown, Lancs, and Newburgh, Aberdeenshire, in August and September. The dark form is found, according to Dr. Morison, principally upon *Glyceria maritima* which is submerged at high tide, and upon *Poa maritima* : it is also recorded upon *Aster tripolium*, *Glaux maritima*, *Elymus arenarius* and *Juncus maritimus*. Dr. Priesner (1924–5) did not obtain the dark form on the coast of the East Frisian Islands (N.W. Germany) but the posterior abdominal segments of specimens collected there on *Ammophila arenaria* were abnormally dark.

2. *Aptinothrips elegans* Priesner.

This species inhabits grass and is doubtless fairly widely distributed in Central and Southern Europe. One specimen was taken at Dawlish, S. Devon, in June 1928, by Dr. R. S. Bagnall, and another, rather doubtfully determined as this species owing to its poor condition, in the British Museum collection bears the label "Mols, Denmark : July 1927 : J. Maltback." Mr. O. John collected numbers in Central France in July and September 1927. The specimens from which Dr. Priesner named the species were found by F. Pillich at Simontornya, Hungary, in November 1924 : these include the male imago.

The species is also recorded from the Pyrenees, and Dr. Priesner has collected it frequently in Hungary upon grasses and also upon *Lathyrus*, *Vicia*, *Coronilla*, and *Galium*. Dr. Priesner's var. *mediterranea* (including a male) was taken at Ragusa (Dubronvik) in Jugoslavia (October 1918), and what appears certainly to be an intermediate between this and the normal *A. elegans* Pr. by Dr. Bagnall at Warmbad, Villach, Austria, in September 1929 : the latter specimen is in the British Museum collection.

3. *Aptinothrips stylifer* Trybom.

A. stylifer probably has a distribution somewhat similar to that of *A. rufus*, being recorded from many parts of Europe and from the United States of America (A. F. Shull). In the Dolomites it has been taken by Dr. R. S. Bagnall at an altitude between 7000 ft. and 7500 ft. in September 1929.

According to U. S. Sharga (1933) the insect would appear often to inhabit localities in which *A. rufus* is not present, and to breed only from April to June, whereas the latter species breeds throughout the year. Dr. Morison obtained three male imagines in Kincardineshire, Scotland, on August 30th, 1928. Usually found upon grasses, including barley, and especially upon *Agrostis canina* ; Dr. R. S. Bagnall collected it from *Fraxinus* at Zurich, Switzerland, in July 1925.

4. *Aptinothrips karnyi* John.

Mr. O. John collected a large number of female imagines on grass at Jarnioux, Dept. du Rhône, Central France, in July 1927 in company with *A. stylifer*. If Dr. Priesner's form *styligera* is identical with this species, *A. karnyi* would also occur with *A. elegans* Pr. (var. *mediterranea*) at Ragusa, Jugoslavia.

5. *Aptinothrips* (?) *melanophthalmus* Bagnall.

The unique type-specimen in the British Museum collection bears the label "S. France, L'Estague near Marseille, 1 ♀ on a crucifer (casual) Sept. 1927 : R. S. Bagnall."

V. YOUNG STAGES OF THE GENUS *APTINOTHRIPS.*

1. *The Larvae.*

Large numbers of 1st and 2nd instar larvae of *A. rufus*, and a smaller number of 2nd instar larvae of *A. stylifer* have been examined. On remounting some 1st instar larvae collected by Dr. Morison from *Agrostis canina*, upon which imagines of both species were present, two were found to differ slightly in structure from the other larvae which are certainly referable to *A. rufus*: it is presumed, tentatively, that these two specimens belong to the species *A. stylifer*. Young stages of other species of the genus have not been obtainable. From the presence, in both instars, of long whip-like setae upon the ventral surface of the meso- and metathoracic segments, and upon the 7th, 9th, and 10th abdominal segments, and in the absence of modified setae upon other portions of the body, the larvae show affinities with those of *Limothrips cerealium* Haliday.

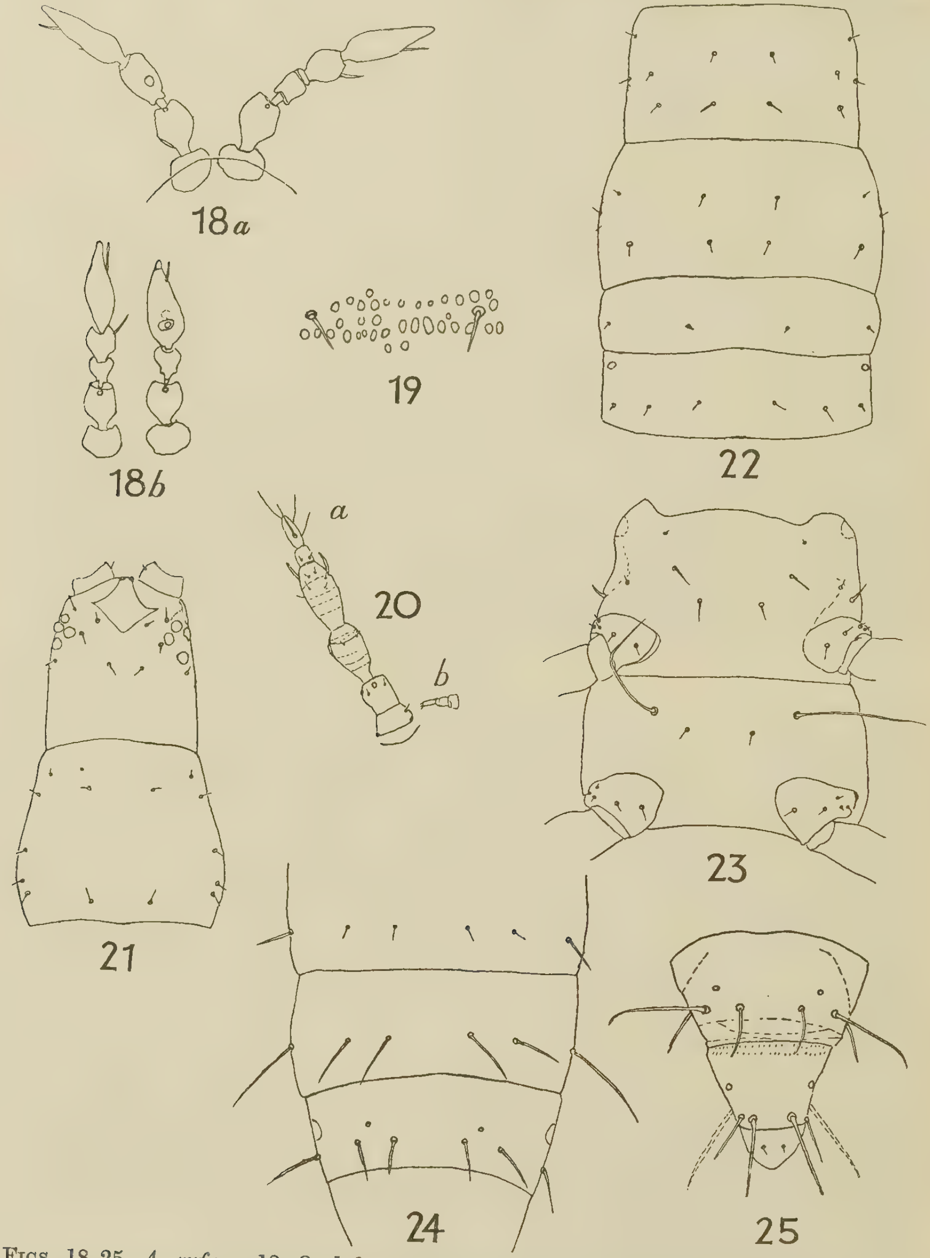
As reference must be made to certain setae upon the abdominal segments, it is convenient to adopt a simple terminology for them. The full complement, upon a single cylindrical segment, comprises six pairs of setae, three pairs of which are best observed in dorsal aspect, and the other three pairs in ventral aspect. It is proposed here to term that pair, each seta of which lies immediately to the left and right of the median line, the median pair, the pair lying nearest to the extreme lateral margin, the marginal pair, and the remaining pair lying between the median and marginal pairs, the lateral pair. There are thus a dorsal-median, dorsal-lateral, and dorsal-marginal pair, and a ventral-median, ventral-lateral, and ventral-marginal pair. On one or other abdominal segment some of these pairs may be wanting, especially upon the ventral surface in the 1st instar larva.

A. rufus.

2nd Instar Larva (figs. 19–25). Shape much as that of the imago; the abdomen broader. Colour pale yellow to orange: a darker diamond-shaped chitinous plate in the anterior region of the head, and a darker plate also to each side. The 9th and 10th abdominal segments similarly darker dorsally. Larvae collected from halophytic plants on the sea-coast are usually bright orange, except for the head and the dark grey terminal abdominal segments. Eyes very dark red. Stigmatal plates well developed, placed at the anterior lateral angles of the meso-thorax, and at the lateral margins of each of the 2nd and 8th, abdominal segments. The whole integument, except that of the head, the two terminal abdominal segments, and the legs, is beset, both dorsally and ventrally, with simple raised chitinous excrescences, oval or round in shape, and arranged in irregular rows: the largest measure about 5 μ in diameter, and they are set at an average of about 2 μ apart from one another (fig. 19).

Antennae (fig. 20 *a*) composed of 6 joints, the 2nd joint with a small circular sensorium placed dorsally and distally, the 4th joint, in the distal region, with two simple trichomes one upon the inner, the other upon the outer margin, in these and other respects conforming to the type of larval antenna usually found in the THRIPIDAE. Maxillary palpi 3-jointed (fig. 20 *b*): labial palpi 2-jointed, the proximal joint very short, and hardly raised above the surrounding surface. Eyes small, composed of some 4 facets. Legs short and broad, beset with short simple setae.

Chaetotaxy:—Inconspicuous setae, in *dorsal* aspect, upon the *head* and divisions of the *thorax* arranged as in figs. 21 and 22. Upon the *head*, in *ventral* aspect, a pair of setae of moderate length stand between the eyes: a similar pair are placed near the frontal suture: the posterior region beset, as in the imago, with inconspicuous setae. Ventral surface of the *prothorax* devoid of setae: the coxae of each side beset with two very short setae. Ventral surface of the *mesothorax*, in addition to the inconspicuous setae arranged as in fig. 23, beset medianly with two pairs of rather longer setae, the anterior of which are not more than three



Figs. 18–25, *A. rufus*.—18, ♀, deformities of antenna, × 200; 19, 2nd instar larva, median portion of 4th abdominal tergum, × 450; 20–25, 2nd instar larva, × 200; 20, *a*, antenna, *b*, maxillary palp; 21, chaetotaxy of head and prothorax, dorsal aspect; 22, of mesothorax, metathorax, 1st and 2nd abdominal segments, dorsal aspect; 23, of meso- and metathorax, ventral aspect; 24, of 6th, 7th, and 8th abdominal segments, dorsal aspect; 25, of 9th, 10th, and 11th abdominal segments, dorsal aspect.

times the length of the posterior pair (cf. *A. stylifer*, fig. 27). Ventral surface of the *metathorax* beset with two pairs of setae, the anterior pair of which are very long (about 75 μ) and whip-like. The coxae of the meso- and metathoracic legs are beset only with very short setae. *Abdomen* (figs. 22, 24, 25 and 26). In the accompanying Table I is shown the approximate length, measured in μ μ, of the setae upon each of the abdominal segments in both dorsal and ventral aspects. It should be noted that the setae in different individuals are subject to some variation in length; especially is this the case with setae measuring about 50 μ and over, which may vary to an extent of some 20 μ on either side of the figure given in the table.

Where no figures are given for a pair of setae, it is implied that this pair is wanting.

Table I.

Aptinothrips rufus.

2nd Instar Larva. Approximate length of setae in μμ.
Mesothorax : *ventral.* Outer (anterior) pair **20**. Inner (posterior) pair 10.
Metathorax : *ventral.* Outer (anterior) pair **75**. Inner (posterior) pair 10.

Abdomen.

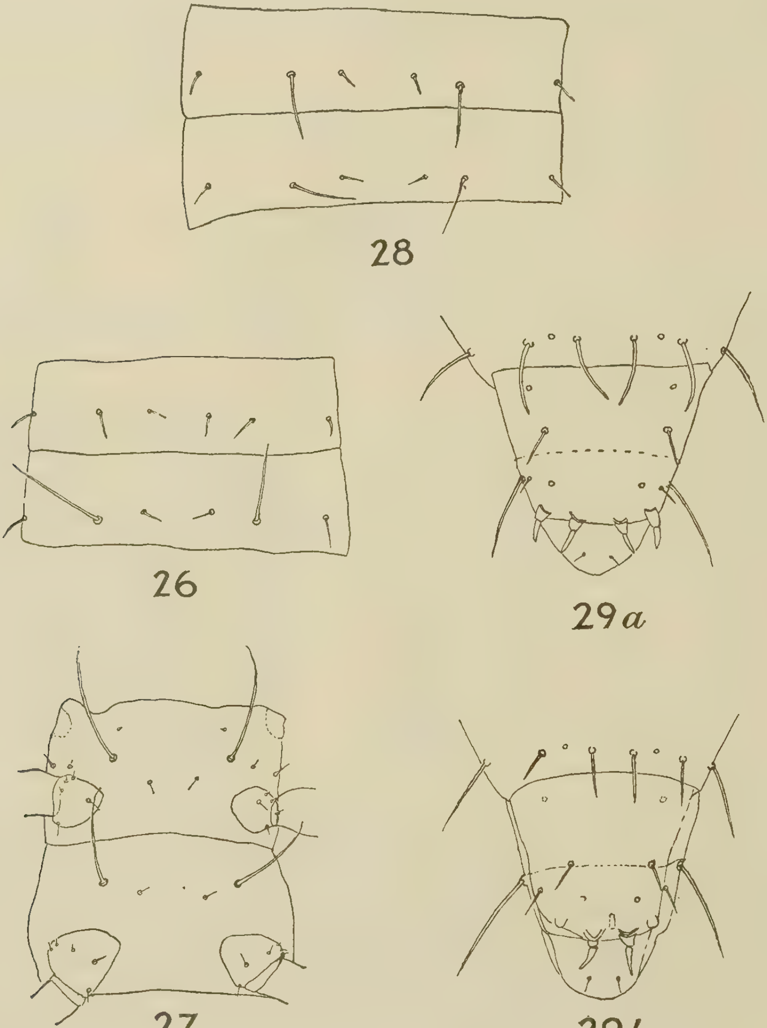
Segment.	Median Pair.	Lateral Pair.	Marginal Pair.	Segment.	Median Pair.	Lateral Pair.	Marginal Pair.
Dorsal I	6	—	8	*Ventral* I	—	—	—
II	10	15	10	II	10	—	—
III	10	10	15	III	10	15	10
IV	12	15	15	IV	10	**15**	15
V	12	17	17	V	12	45	25
VI	15	20	25	VI	15	45	30
VII	30	40	70	VII	30	55	65
VIII	**25**	25	45	VIII	25	30	35
IX	25	55	20 (very fine)	IX	—	25	45
				X	—	55	**55**
X	—	45	25 (very fine)	XI	4 pairs of inconspicuous setae		
XI	—	4	—				

The figures in heavy type indicate differences between this species and *A. stylifer.*

A pair of dorsally-placed seta-pits are present upon each of segments VIII, IX and X, that upon the 8th segment probably being of generic importance. The great length and whip-like nature of the dorsal marginal, the ventral lateral, and ventral marginal pairs of setae upon segment VII, the ventral lateral pair upon segment VI, the dorsal lateral pairs upon segments IX and X, and the two ventral pairs on segment X are probably also to some extent diagnostic of the genus *Aptinothrips.*

1st Instar Larva. The 1st instar larva differs from that of the 2nd instar in its chaetotaxy as follows :—

The ventral surface of the meso- and metathorax is devoid of setae : upon the coxae of the legs of these segments there is, on each, a long whip-like seta (about 65 μ in length). Upon the *ventral* surface of each of abdominal segments III to VIII inclusive, only the median pair of setae are represented, the lateral and marginal pairs being entirely absent : the ventral surface of the 9th segment is (in *A. rufus*) devoid of setae, and the two pairs upon the 10th segment are much longer in proportion than those of the 2nd instar larva. The dorsal lateral pairs of setae of the 9th and 10th abdominal segments are also longer by far than those of the 2nd instar larva.



Figs. 26–29.—*Aptinothrips*—diagnostic characters for young stages—× 200; 26, *A. rufus*, 2nd instar larva, 4th and 5th abdominal segments, ventral aspect; 27–28, *A. stylifer*, 2nd instar larva; 27, meso- and metathorax, ventral aspect (cf. Fig. 23); 28, 4th and 5th abdominal segments, ventral aspect; 29, *Aptinothrips* ♀, pupa, 8th–11th abdominal segments, dorsal aspect, *a*, *A. rufus*, *b*, *A. stylifer*.

For comparison with *A. stylifer* and with the 1st instar larvae of other species which may be obtained later, the approximate length of the setae is given in Table II.

TABLE II.

Aptinothrips rufus.

1st Instar Larva. Approximate length of setae in μ.
Mesothoracic coxa. Long seta 65.
Metathoracic coxa. Long seta 65.

Abdomen.

Segment.	Median Pair.	Lateral Pair.	Marginal Pair.	Segment.	Median Pair.	Lateral Pair.	Marginal Pair.
Dorsal I	4	—	—	*Ventral* I	—	—	—
II	5	8	5	II	5	—	—
III	5	8	10	III	5	—	—
IV	5	10	10	IV	8	—	—
V	5	10	10	V	10	—	—
VI	8	10	10	VI	15	—	—
VII	25	20	65	VII	25	—	—
VIII	15	15	20	VIII	20	—	—
IX	20	85	25 (very fine)	IX	—	—*	—
				X	—	65	55
X	—	75	25 (very fine)	XI	4 pairs of inconspicuous setae.		
XI	—	2	—				

* A pair of setae appears to be present in this position in *A. stylifer.*

A. stylifer.

2*nd Instar Larva* (figs. 27 and 28). This differs only from the 2nd instar larva of *A. rufus* (Gmel.) Hal. in points of the chaetotaxy of the ventral surface of the mesothorax and of the 4th abdominal segment. The outer anterior pair of setae upon the ventral surface of the mesothorax are long (about 45 μ) and at least four times as long as the inner posterior pair. The former and the anterior pair upon the ventral surface of the metathorax do not appear to be so long as the corresponding setae in *A. rufus*, but such a distinction is not to be relied upon.

The ventral lateral pair of setae upon the 4th abdominal segment are about four times as long (about 40 μ) as the median pair, whereas in *A. rufus* they are only slightly longer.

1*st Instar Larva.* The long setae upon the meso- and metathoracic coxae are about 45 μ in length (65 μ in *A. rufus*), but this distinction is not to be relied upon. In the only two specimens obtained which appear to belong to this species, there is a pair of lateral setae (about 15 μ long) upon the ventral surface of the 9th abdominal segment: these are not represented in the 1st instar larva of *A. rufus.* Otherwise no distinction can be found between the 1st instar larvae of the two species.

2. *The Pupae* (fig. 29 *a* and *b*).

In Dr. Morison's collection is a considerable number of prepupae and pupae of *A. rufus* (Gmel.) Hal., including those of the dark form from halophytic plants: there is also a single male pupa of this species. In addition, there is a single pupa of the species *A. stylifer* Trybom. Both pupal stages are devoid of wing-cases, but differ from the 2nd instar larva in the absence of excrescences upon the integument and in the structure of the 9th and 10th abdominal segments. The suture between the latter segments is extremely ill-defined, and, as is usual in Thysanopteran pupae, the posterior portion of the 10th abdominal segment bears dorsally a number of prominent hook-like processes : a pair of sheaths of the future ovipositor are present upon the ventral surface of each of the 8th and 9th abdominal segments. The antennae, mouth-parts, and palpi are encased, and the pupal, as is usual, is distinguished from the prepupal stage in having the antennae thrown backwards over the head. The chaetotaxy of both pupal stages, with the exception of the 9th, 10th and 11th abdominal segments is similar to that of the 2nd instar larva.

The characters of the chaetotaxy which serve to separate *A. rufus* from *A. stylifer* in the 2nd larval instar, also distinguish the pupae of these two species from one another.

In the only specimen of the pupa of *A. stylifer* which has been obtainable, the outer pair of hook-like processes represented in both prepupa and pupa of *A. rufus* (fig. 29 *a*) upon the dorsal surface of the 10th abdominal segment, are entirely rudimentary (fig. 29 *b*). It is possible, but unlikely, that these outer processes were removed in preparation. The pupa in question shows clearly the " styled " antenna within the antennal sheaths.

LITERATURE REFERRED TO IN THE TEXT.

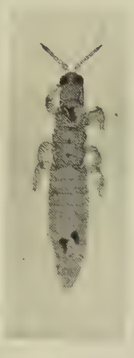
1921. PRIESNER, H. *Ent. JahrB.*, **1921** : 162–166.
1924. PRIESNER, H. *Ent. JahrB.*, **1924–5** : 165–166.
1934. SPEYER, E. R. *Ann. appl. Biol.*, **21** : 120–152.

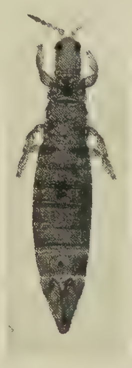
EXPLANATION OF PLATE XIV.

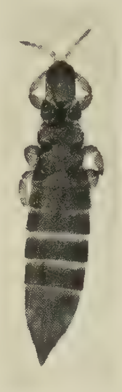
The Genus *Aptinothrips* Haliday.

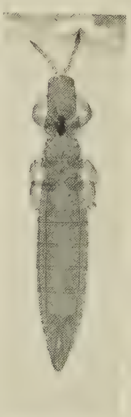
× 35.

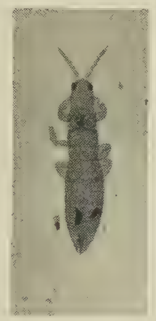
FIG. 1. *A. rufus* (Gmel.) Hal., ♂. Light form.
2. *A. rufus* (Gmel.) Hal., ♀. Light form.
3. *A. rufus* (Gmel.) Hal., ♀. Dark form.
4. *A. elegans* Priesner, ♀ (" Potashed " specimen).
5. *A. stylifer* Tryb., ♂.
6. *A. stylifer* Tryb., ♀.
7. *A. karnyi* John, ♀.
8. *A. rufus* (Gmel.) Hal., 2nd Instar Larva (" Potashed " specimen).
9. *A. rufus* (Gmel.) Hal., Prepupa.
10. *A. stylifer* Tryb., Pupa.

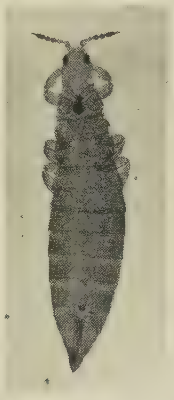

1

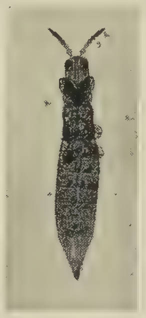

2

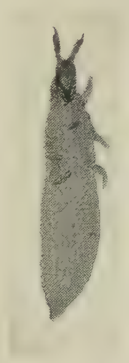

3

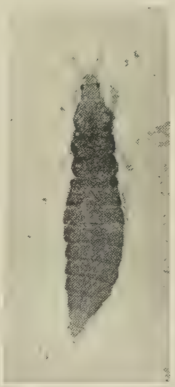

4

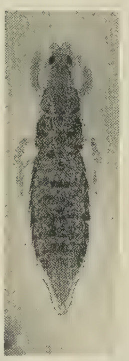

5


6


7


8


9


10

The genus *Aptinothrips* **Haliday.**

THE ORIGIN OF GYNANDROMORPHS IN THE LEPIDOPTERA FROM BINUCLEATE OVA

By E. A. Cockayne, D.M., F.R.C.P.

[Read 1st May, 1935.]

Morgan in his *Origin of Gynandromorphs* has shown that in *Drosophila* the majority are produced by the elimination of an X-chromosome at the first division of the fertilised ovum or during mitosis at some subsequent cell division, the X-chromosome that is lost being as often that derived from the female parent as that derived from the male parent. The evidence is obtained partly from the somatic characters of the two parts, the male part with only one X-chromosome often showing a sex-linked recessive character, which is masked in the female part by the second X-chromosome, and partly by cytological examination. He admits, however, that a few are produced from binucleate ova, each nucleus fertilised by a different spermatozoon.

In his discussion of the origin of lepidopterous gynandromorphs he brings forward incontrovertible proof that two examples of *Abraxas grossulariata* L. must have been produced by chromosome elimination, and assumes that most of the others originate in the same way, though he may have modified his views since then. In Lepidoptera the sex-chromosome eliminated is a Z-chromosome, the male being constituted ZZ and the female ZW. In both cases the proof was obtained from a knowledge of the parentage, and I believe that there is no cytological proof that chromosome elimination can produce a gynandromorph in the Lepidoptera.

The object of this paper is to show that a large number of lepidopterous gynandromorphs arise from binucleate ova.

The best known gynandromorphs are those in which one side is male and the other female, but in some the division is not quite perfect and there is a streak or patch of male colour on the female side or vice versa. In other gynandromorphs, though the male and female parts are approximately equal in extent, their arrangement is very irregular, and sometimes in these mixed gynandromorphs the parts belonging to the one sex may greatly exceed those belonging to the other. Occasionally a specimen is found in which the anterior half is of one sex and the posterior half of the other sex, fore and aft gynandromorphs. There is evidence that all these types can arise either by the elimination of a Z-chromosome or from a binucleate ovum.

In some species one type is commoner; for instance in *Euchloë cardamines* L., *Gonepteryx rhamni* L., and *G. cleopatra* L., the majority show a mixture of male and female parts on both sides, while in *Limenitis populi* it is usual to find one side male and the other female.

(1) *Gynandromorphs with different somatic characters, not sex-linked, in the male and female parts.*

If a gynandromorph shows in the male parts a recessive autosomal character and in the female parts the corresponding dominant one or vice versa, this cannot be accounted for by the elimination of a Z-chromosome, and it is very unlikely that an autosome as well as a sex-chromosome has been eliminated.

A much more probable explanation is that such a gynandromorph has arisen from a binucleate ovum, and this becomes still more probable, when two or more gynandromorphs, differing in the same somatic characters in their male and female parts, appear in the same brood. This has happened in the case of *Aglia tau* L., *Ptychopoda seriata* Schrank, and *Hemerophila abruptaria* L.

Though the parts of an insect derived from a binucleate ovum may differ both in sex and in some conspicuous somatic character, this is not always the case; they may differ in the somatic character alone, and are then known as somatic mosaics. The existence of mosaics and gynandromorphs of the same species, showing the same dominant and recessive characters in the two parts, is an additional piece of evidence in favour of the origin of both from binucleate ova, and examples of this are known in *Aglia tau*, *Lymantria monacha* L., *Colias croceus* Fourcr., and *Papilio glaucus* L.

There is also cytological evidence that binucleate ova occur in Lepidoptera. Doncaster found them not infrequently in a strain of *Abraxas grossulariata* L., which he was using for breeding experiments, and showed that each nucleus could be fertilised by a different spermatozoon, and more recently they have been demonstrated in *Bombyx mori* L.

In most cases, in which different forms are present in the male and female parts of a gynandromorph, one form is much rarer or more local than the other, and gynandromorphs alike in somatic characters in the two parts, but originating in the same way as the others, must be much commoner.

Aglia tau provides the greatest number of gynandromorphs with a segregation of somatic and sexual characters. There is a record of one with the left side female *tau* and the right side male ab. *nigerrima* Stdfs. In one brood four gynandromorphs were bred, all of which had the male and female parts distributed irregularly on both sides; two had the male parts *tau* and the female parts ab. *fere-nigra* Th.-Mieg. (*lugens* Stdfs.), one had the male parts *fere-nigra* and the female parts *tau*, and in the fourth both male and female parts were *fere-nigra* (1886, *Ent. Ztg.*, *Stettin*, **47**: 320). In 1910 Standfuss stated that *fere-nigra* was due to a dominant autosomal gene in the heterozygous state and that *nigerrima* was due to the same gene in the homozygous state, but in the gynandromorph mentioned next the melanic form, which is also called *fere-nigra*, is undoubtedly due to a recessive autosomal gene.

Standfuss gave a coloured plate of this insect, of which the ancestry for some generations and the immediate parentage were known; the male parent was ab. *huemeri* Stdfs. with a marginal band, linked recessive characters, and was heterozygous for the recessive character *fere-nigra*, while the female parent was heterozygous for both *fere-nigra* and for *huemeri* with a band, and was typical *tau* in appearance. The brood produced three males and four females, which showed the characters of both *fere-nigra* and *huemeri* with a band, and eight males and four females, which were typical *tau*, and in addition there was the gynandromorph, which was male *fere-nigra* and *huemeri* with a band on the left side and female *tau* on the right side. There was also a second gynandromorph pupa, which failed to hatch (1917, *Mitt. ent.*, *Zurich*, **3** : pl. VI.).

In addition to these gynandromorphs with different somatic characters in their male and female parts there are records of four halved ones, five irregularly mixed, and one with the fore-wings female and the hind-wings male, in all of which both male and female parts are *tau*. There is one with both male and female parts *nigerrima* distributed irregularly, and a third with both parts ab. *cupreola* Werner, the heterozygote of ab. *melaina* Gross. Standfuss also records a crippled gynandromorph, with the left side male and the right side female, both sides ab. *melaina*, a black dominant or epistatic form. The male parent was *tau* and the female parent ab. *melaina*.

Two gynandromorphs of *Ptychopoda seriata* Schrank were bred by Habich from ova laid by a melanic female, both were typical pale grey and female on the right side and melanic, ab. *cubicularia* Peyer. (*bischoffaria* Lah.), and male on the left side. The rest of the brood consisted of both typical and melanic moths, the melanic form being an autosomal dominant (1894, *Ent. Ztg.*, *Stettin*, **55** : 131, pl. V, fig. 1). Bacot bred another, the left side male ab. *cubicularia* and the female side typical, the remainder of the brood consisting of both melanic and typical forms (1913, *Proc. ent. Soc. Lond.*, **1913** : xi, xii).

Simmons bred four gynandromorphs of *Hemerophila abruptaria* L. in a single brood, one parent being a wild melanic female and the other a bred typical male. One had the left side female and typical and the right side melanic, ab. *fuscata* Tutt; one had the left side female and typical, with the exception of a melanic patch on the upperside of the hind-wing and another on the underside of the fore-wing, and the right side male and melanic; the third had the left side male and typical and the right side female and melanic, the abdomen being stout and half typical, half melanic; the fourth had the left side female and typical and the right side male and melanic. It has been proved on numerous occasions that the melanic chocolate-coloured form, ab. *fuscata* Tutt, is dominant or epistatic to the straw-coloured typical form and that the gene is in an autosome. Three other halved gynandromorphs are known with both male and female parts typical.

Two gynandromorphs of *Biston betularia* L. are mentioned in Schultz's lists, one with the right side female ab. *carbonaria* Jordan (*doubledayaria* Mill.) and the left side male of the intermediate form, ab. *insularia* Th-Mieg. (*mixtus* Stgr.), the other with mixed male and female parts, the former *insularia* and the latter *carbonaria*, on both sides. The black *carbonaria* is an autosomal dominant to the intermediate, ab. *insularia*. In the same lists are six gynandromorphs with male and female parts mixed, but both typical. Harrison and Main bred seven halved gynandromorphs of this species and a male with antennae almost simple, which is probably an eighth, from ova laid by one female, the rest of the brood consisting of twenty males and forty females. Both gynandromorphs and normal specimens were typical. There is also an unrecorded gynandromorph with both male and female sides ab. *carbonaria*.

Duponchel gave a coloured plate and a description of a gynandromorph of *Angerona prunaria* L. with the right side male ab. *corylaria* Thnbg. and the left side female and typical (1835, *Ann. Soc. ent. Fr.*, **4** : 143, pl. 1, fig. 5), and I have one which is male ab. *corylaria* on the left side, and has the right fore-wing female and typical with the exception of streaks and spots of ab. *corylaria* male and the right hind-wing nearly all ab. *corylaria* male. The banded ab. *corylaria* is an autosomal dominant to the plain typical form. Schultz mentions thirteen other gynandromorphs, two halved, one of which is entirely typical, one entirely *corylaria*, and the third largely male and entirely *corylaria*. Another, bred by Pickett, has the left fore-wing and right hind-wing male, and the right fore-wing and left hind-wing female, but for a few flecks of male colour near the margin. Both male and female parts are *corylaria*. The remainder are either *prunaria* or incompletely described.

A brood of *Clostera curtula* L. from Green Street near Faversham produced at least one male and six females of a melanic form, ab. *webbiana* Rebel, as well as typical examples, and also included a gynandromorph with the left side male and melanic and the right side female and typical (1878, *Entomologist*, **11** : 169). I can find only one other record of this melanic form, a specimen bred by Wittich (1875, *Entomologist*, **8** : 134), and it is uncertain whether it is dominant or recessive, but it is fairly certain that the melanic and typical forms bear a simple mendelian relationship to one another and that the gene lies in an autosome. One halved and two mixed gynandromorphs with both male and female parts typical are mentioned in Schultz's lists.

Of *Lymantria monacha* L. there are two halved gynandromorphs, one with the left side female and typical and the right side male ab. *eremita* O., the other with the left side male and typical and the right side female ab. *eremita*, and a third with the left fore-wing female and typical and all the rest including both antennae and the abdomen male ab. *eremita*. There are also two halved examples of the typical form, a mixed one with both male and female parts ab. *eremita*, a mixed one entirely typical and one undescribed. Somatic mosaics have also been recorded. From a pairing of the type and ab. *eremita*, two males and twenty females of the typical form and eighteen males and two females ab. *eremita* were bred and in addition six somatic mosaics, five males and one female with a coarse mosaic of the black and white of the typical form and the black of ab. *eremita* (Standfuss, 1896, *Handb. paläarct. Schmett.* : 308). Stichel gave a figure and description of a female mosaic with the left side rather darker than the type and the right side ab. *eremita*, the left side of the abdomen pink and the right side black (1912, *Z. wiss. InsektBiol.*, **8** : 41). The melanic ab. *eremita* appears to be an autosomal dominant. It is interesting that in this species the binucleate ova may have both nuclei with Z or with W-chromosomes, as often as one with a Z and the other with a W-chromosome.

There is a gynandromorph of *Lasiocampa trifolii* Esp. with the right side female *trifolii* and the left side male f. *medicaginis* Borkh. Five halved examples and three incompletely described have both male and female parts *trifolii*, one halved example has both sides ab. *flava* Tutt, and one has both sides f. *medicaginis*. The genetic relationship of *trifolii* to *medicaginis* is not known, but evidently neither is sex-linked.

Gynandromorphs of *Limenitis populi* L. are rather common, three have the right side male ab. *tremulae* Esp. and the left side female *populi*, and three others have a mixture of the two forms. Twelve halved examples, eight mixed, one fore and aft, and one undescribed gynandromorph with both male and female parts *populi* are recorded. ab. *tremulae* must be determined by an autosomal gene, though its genetic relationship to *populi* is not known.

Of *Apatura ilia* Schiff. there are a number of gynandromorphs recorded. There are three halved with the left side male *ilia* and the right side female ab. *clytie* Schiff., three halved with the right side male ab. *clytie* and the left side female *ilia*, one with the right side male *ilia* and the left side female ab. *clytie*, and one with the left side male ab. *clytie* and the right side female *ilia*, and one mixed with the female parts *ilia* and the male parts *clytie*. There are also three halved examples and seven mixed ones with both male and female parts *clytie*, and four mixed ones with both parts *ilia*, and one mixed one with both parts *asterioides* Stgr. A somatic mosaic is also recorded, a male with the right side typical and the left side ab. *silvia* Cabeau. Though the relationship of *ilia* to *clytie* is not known, *clytie* cannot be sex-linked.

A gynandromorph of *Pieris napi* L. with the left side female ab. *citronea* Frohawk (recorded as ab. *sulphurea* Schöyen), and the right side male and typical is figured by Frohawk (1928, *Entomologist*, **61** : 76), and on the same plate is a figure of another with the left side female and the right side male, both ab.

citronea. A halved example with both sides typical, another with both sides ab. *napaeae* Esp. and three mixed examples with both male and female parts typical are mentioned by Schultz in his lists, one with the right side male and the left side female, both *napi*, is described in the *Rev. Soc. ent. namur.* **1925**, and two others with both male and female sides *napi* are recorded in the *Entomologist* for 1909 and 1921. Those partly *napi* and partly *bryomiae* are referred to later. The ab. *citronea* Frohawk has been bred by H. W. Head for many years and are all the descendants of a single specimen from Donegal. No details have been published which throw light on the genetics of this form, but I have received some information in a private letter. Many years ago a pairing between two ab. *citronea* produced a brood of about a hundred normal *napi*, and two years later an equally large number of normal *napi* was bred from a similar pairing. No record was kept and it is probable that some mistake occurred. In recent years some *citronea* have been bred from pairings between two normal *napi*, and when both parents are *citronea* nearly all the offspring are *citronea*. Broods are usually mixed and bred in a large outdoor cage. In the absence of exact data the genetic relationship of the two forms is still uncertain, but it is probable that *citronea* is recessive to normal *napi*.

A gynandromorph of *Pieris rapae* L. with the left side female ab. *flavescens* Röber and the right side male and white with streaks of yellowish-brown female colour is recorded (1908, *Soc. Ent.*, **23** : 80). There is also a mixed example with both male and female parts *flavescens*, and two halved examples with both sides typical in the lists published by Schultz, and another predominantly female is figured by Frohawk (1921, *Entomologist*, **54** : 201).

A mixed gynandromorph of *Ematurga atomaria* L., of which the male parts are melanic, ab. *unicoloraria* Stgr., and the female parts typical, was bred from a larva from Bury, where the melanic form is taken regularly. It occurs equally commonly in both sexes, and is therefore determined by an autosomal gene, either dominant or recessive. Three gynandromorphs of this species, two halved and one mixed, with both male and female parts typical are mentioned by Schultz.

Two gynandromorphs of *Dicycla oo* L., one perfectly and the other almost perfectly halved, with the right side male and typical and the left side female and banded, ab. *renago* Haw., are reported in Schultz' lists, and since males of each form are as common as females neither can be sex-linked.

In the following cases the difference in somatic colours occurred in the larva and not in the imago. A gynandromorph of the silkmoth *Bombyx mori* L. was bred by Toyama from one of two silkworms, both of which were zebra-pattern on one side and unicolorous white on the other. The female parent was zebra-pattern as a larva and the male parent white, and zebra is an autosomal dominant to white. The female half of the gynandromorph, the left, was zebra-pattern in the larva and the male half, the right, was white. The simplest explanation of this case is that the zebra female parent was heterozygous and the binucleate ovum had one nucleus Z and white, the other W and zebra, each nucleus being fertilised by a Z-bearing spermatozoon carrying the autosomal gene for white.

Mayer records a larva of the same species, obtained by crossing a moth of Italian with one of French race, which was black on the right side and white on the left side. This produced a gynandromorph with the right half male and the left half female. Black appears to be the extreme form of zebra, determined by a dominant autosomal gene, and this insect also must have arisen from a binucleate ovum (1909, *Ent. Z.*, **23** : 103).

Blaringhem (1913) records a mosaic larva with the right side white and the left side zebra with some white patches on the posterior half. Mosaics and gynandromorphs of *Bombyx mori* are also recorded by Ikeda (1908), Takahashi (1914), Tanaka (1916), and Yagi (1924) in Japanese periodicals.

The following is a list of other gynandromorphs showing different forms in the male and female parts. The genetic relationship of the two forms is unknown in all of them, but they must be determined by autosomal genes, because they are as common in one sex as in the other. *Endrosa aurita* Sulz., left side *aurita* male, right side ab. *ramosa* F.; *Diaphora sordida* Hbn., left side female ab. *trifasciata* Spul., right side male ab. *carbonis* Frr.; *Zygaena trifolii* Esp., right side male ab. *orobi* Hbn., left side female ab. *minioides* Selys. (*confluens* Stgr.); *Metachrostis perla* F., left side male and pure grey in colour, right side female with ochreous ground, ab. *flavescens* Tutt; *Erebia pronoe* Esp., right side male ab. *pitho* Hbn., left side female *pronoe*; *Abraxas grossulariata* L., left side male and blue-black in colour, ab. *nigrocaerulea* Rayn., right side female and typical (1915, *Entomologist*, **48** : 57, fig.).

With the exception of the domesticated silkmoth *Amorpha populi* L. produces more gynandromorphs than any other species, 99 having been recorded prior to 1905, and some of them differ in coloration as well as in sex on the two sides. Four at least are known with one side pink, ab. *roseotincta* Reuter, and the other side grey, both these colours being equally common in males and females and therefore not due to sex-linked genes. Two or more gynandromorphs have appeared in a single brood on more than one occasion. Shuttleworth, for example, bred two from ova laid by a female in 1880 (1880, *Entomologist*, **13** : 116) and in 1914 H. B. Williams bred two from one batch of eggs, and would probably have bred others, if most of the pupae had not died during the winter.

L. W. Newman, shortly before the war, had a strain, which produced about four per cent. of gynandromorphs, some male on one side and female on the other and some with the male and female parts less regular in distribution. In successive years he bred 17, 14, 11, and 2 out of totals, in round numbers, of 2000, 1500, 1000, and 800, and from 500 of his pupae I bred 3 in 1914. His broods were not kept separate, and it is probable that in some broods there were none and in others more than four per cent. Amongst these gynandromorphs were three of the four mentioned above, which were pink on one side and grey on the other.

The hybrids obtained by crossing *Smerinthus ocellatus* L. male with *Amorpha populi* female, *Smerinthus* hybrid *hybridus* Stephens, are interesting. Before Newman had his strain of *populi* only three hybrids with one side male and the other female were known, but, using females of this strain in his crosses, five more hybrid gynandromorphs of this kind were bred. One brood in 1912 consisted of 25 males, 10 intersexes, and 2 halved gynandromorphs, and another in 1914–15 consisted of 13 males, 3 intersexes, and 1 halved gynandromorph. Whicher in 1915, by crossing a male *ocellatus* with a female *populi* of Newman's strain, bred two gynandromorphs with one side male and the other side female (1915, *Entomologist*, **48** : 124, pl. 8, pl. 6, fig. 4). This proves that the gynandromorphism is due to the female parent, and the fact that in three *populi* there was a division, not only into two sexes, but into two colours determined by autosomal genes, shows that the elimination of a sex-chromosome is not the cause of the gynandromorphism. There can be little doubt that these gynandromorphs of *populi* and hybrid *hybridus* originated from binucleate ova and that the tendency to produce such ova was hereditary. It is probable that the great majority of gynandromorphs of *Amorpha populi* originate in the same way and that binucleate ova are comparatively common in this species.

(2) *Gynandromorphs with a sex-limited character on the female side determined by a gene in the W-chromosome.*

Pieris napi L. has an alpine race differing very greatly in the female sex from the lowland race. This radiated and suffused form of female, ab. *bryoniae* O., is strictly sex-limited. Where the races intermingle there are no intermediates between ab. *bryoniae* and typical female *napi*. Harrison and Main crossing the two races found that, when males of the alpine race, producing *bryoniae* females, were crossed with *napi* females, all the females were typical *napi*, both in the first generation and in the next generation, when they were crossed *inter se*. On the other hand, when *napi* males of the lowland race were crossed with *bryoniae* females, all the females were *bryoniae* (1908, *Proc. ent. Soc. Lond.*, **1908** : lxxxvii; 1912, *loc. cit.*, **1912** : lxxii). Fischer also paired *napi* males with *bryoniae* females, *napi* males with females from this cross, and males and females obtained from the cross. All the females were *bryoniae*, though those which hatched the same year had unusually black spots and apices. A male of the *bryoniae* race crossed with a female *napi* only produced males. There was one apparent exception. A male and female obtained by crossing *napi* male with *bryoniae* female were paired *inter se*, the female being very weakly marked, and produced females resembling ordinary *napi* (1925, *Mitt. schweiz. ent. Ges.*, **13** : 416).

The simplest explanation of this matrilineal descent is that the *bryoniae* character is determined by a gene in the W-chromosome. Males of the alpine race, being ZZ in constitution, cannot transmit the *bryoniae* character, whereas females transmit their W-chromosome to all their female offspring and with it the *bryoniae* character. This is equally true whether the lowland and alpine forms are races of one species or, as Müller believes, two separate species.

It is obvious that, if this explanation is correct, the elimination of a Z-chromosome cannot account for a gynandromorph with the female parts *bryoniae*, since it would only have one Z-chromosome and no W-chromosome in its cells.

At least five such gynandromorphs are known, two with the left side male *napi* and the right side female *bryoniae*, one with the right fore-wing male *napi* and the other three wings female *bryoniae*, one with the left hind-wing male *napi* and the other three wings female *bryoniae*, and one all male *napi* with the exception of part of the left fore-wing, which is female *bryoniae*. These probably originated from binucleate ova, one nucleus with a Z and the other with a W-chromosome, the nuclei being separately fertilised by Z-bearing spermatozoa.

(3) *Gynandromorphs with the female parts showing a sex-limited character probably due to a dominant autosomal gene with an additional gene in the W-chromosome.*

It is well known that *Argynnis paphia* L. has a blackish-green sex-limited form of female, ab. *valesina* Esp., and that nearly every species of the genus *Colias* has a white or very pale sex-limited form of female. It has been proved conclusively that in *paphia* and in *Colias philodice* Godt., the sex-limited female form is due to a dominant autosomal gene, and that, even when homozygous for this gene, the males are indistinguishable from typical males, in which it is absent. In the case of *C. croceus* Fourc., and *C. eurytheme*, the sex-limited forms of female, ab. *helice* Hb., and ab. *albina*, are also dominant and the gene is in an autosome. *Papilio polytes* L., has three forms of female, two of which, *polytes* L., and *romulus* Cram., are sex-limited. Fryer has shown that *polytes* is dominant to the male-like female *cyrus* Fabr., and *romulus* to *polytes*, and concludes that *polytes* is due to a dominant autosomal gene, and that *romulus* has a second dominant autosomal gene, which modifies the gene for *polytes*, when this is present, but in its absence has no effect. The yellow American *Papilio glaucus* L., also has, in addition to the male-like form, a sex-limited form of female, which is black. This is absent in the northern part of its range and gradually becomes commoner towards the south. The evidence as to its genetic behaviour is scanty, but the hypothesis that the black female is due to the combined action of a dominant autosomal gene and one in the W-chromosome fits the actual results obtained by breeding.

In the case of *paphia* observations in the field support those obtained by breeding experiments. All the females of *paphia* in the eastern part of its range are *valesina* and presumably all the males are homozygous for this character, though they all have the typical fulvous ground-colour.

To explain this type of inheritance I have put forward a hypothesis, which gives theoretical results in perfect agreement with those obtained by breeding experiments (1932, *Entomologist*, **65** : 169). I suggested that there is a gene in the W-chromosome, which acts in conjunction with the dominant gene in the autosome, and that both must be present in order to produce the sex-limited character. It might be thought that the mere fact of being female would allow of the development of the sex-limited character, as in the case of ordinary sexual dimorphism, which is due to the balance between Z-chromosomes and autosomes and is quite independent of the W-chromosome, but, if this were so, there could be no males with the sex-limited character and the nine recorded male *valesina* could not be accounted for. On my hypothesis male *valesina* are due to non-disjunction, two Z-chromosomes adhering and behaving as one during mitosis, a phenomenon, which is known to occur occasionally in Lepidoptera. *valesina* males would be constituted ZZW, and would be male because of their two Z-chromosomes and *valesina* because of the presence of a W-chromosome and an autosome carrying the dominant gene for *valesina*.

If this is accepted, elimination of a Z-chromosome might produce an ordinary gynandromorph of *paphia* or any of the other species mentioned above, but could not produce one with the sex-limited character on the female side, because this would have no W-chromosome. Schultz in his lists of palaearctic gynandromorphs mentions fourteen with one side male *paphia* and the other side female *valesina* and two others with a less regular arrangement of the male and sex-limited female coloration. One with the left side male *paphia* and the right side female *valesina*, bred in 1923, is described by Hering (1924, *Zool. Anz.*, **58** : 74), and another, also with the left side male *paphia* and the right side female *valesina*, is recorded from the New Forest (1918, *Entomologist*, **51** : 214), and Dr. Gifford Nash took a similar specimen in the same locality. One with three wings female *valesina* and the fourth wing partly *valesina* and partly male *paphia* has been recorded (1919, *Entomologist*, **52** : 48), and Flick gives a figure of one with the left side *valesina* and the right side male *paphia* with the exception of a streak of *valesina* in the middle of the fore-wing (1926, *Z. österreich. Ent. Ver.*, **12** : 66).

Schultz also mentions thirty-two gynandromorphs, half male and half female, ten with the male and female parts distributed irregularly, and nineteen described too incompletely for classification, in all of which both male and female parts are typical *paphia*. Another halved example is described by

Hering, and one was taken by F. Nicholls in the New Forest in 1916, and in both the female half is *paphia.*

Gynandromorphs with the female portion of typical coloration should outnumber those with *valesina* coloration, because *valesina* is absent or rarer than the type in many localities and is commoner than *paphia* only in a small part of its range. It has been estimated that in the New Forest there is only one *valesina* to thirty *paphia* females, so that in this locality ordinary gynandromorphs produced from binucleate ova should be thirty times as common as those with the female parts *valesina*, though the latter would be much more conspicuous and therefore a higher proportion of them would be caught.

A paper, which adds considerably to our knowledge of gynandromorphism in this species, has been published by Goldschmidt and Fischer (1927). In the course of extensive breeding experiments they obtained twenty-five gynandromorphs, eleven of which were half male and half female. Eight had the female parts *valesina* and five of these were *valesina* on one side and male *paphia* on the other, the remainder showing an irregular distribution of male *paphia* and female *valesina.* All the gynandromorphs were descendants of one female, but out of sixty-two broods only sixteen had one or more gynandromorphs in it. From one female belonging to the fourth generation six gynandromorphs were descended, one or two appearing in every brood for the next four generations. The broods of which an exact record was kept were as follows—2 males, 7 females, 1 gynandromorph; 54 males, 65 females, 1 gynandromorph; 43 males, 52 females, 1 gynandromorph; 32 males, 31 females, 2 gynandromorphs; 42 males, 25 females, 5 gynandromorphs; 174 males, 222 females, 3 gynandromorphs; 142 males, 113 females, 1 gynandromorph; 104 males, 90 females, 2 gynandromorphs; 122 males, 91 females, 1 gynandromorph; 111 males, 114 females, 2 gynandromorphs; 144 males, 151 females, 1 gynandromorph; 45 males, 74 females, 1 gynandromorph; 36 males, 40 females, 1 gynandromorph; 88 males, 80 females, 1 gynandromorph.

The authors consider that the gynandromorphs originated from binucleate ova, and that the tendency to produce such ova was inherited. Binucleate ova can only produce gynandromorphs if one nucleus has a Z and the other a W-chromosome, those with a Z in each would produce males and would be unrecognisable, and those with a W in each would produce females and would only be recognisable if they were mosaics, partly *valesina* and partly typical *paphia.* Ten of the sixteen broods produced both *paphia* and *valesina* females and, if binucleate ova with a W-chromosome in each nucleus had been present, such mosaics might have appeared in them. There were none, however, and presumably such ova are much rarer than those with a Z in one and a W-chromosome in the other nucleus. Indeed, only one mosaic of this kind has been recorded and the so-called *valesina* coloration of one side was probably due to a defective development of the scales.

Several gynandromorphs in different species of *Colias* with the female side showing the sex-limited coloration are known. Schultz in his lists has collected two examples of *Colias croceus* Fourc., one with the left side male and the right side female ab. *helice* Hbn., the other with the right side male and the left side female ab. *helice.* He also mentions three halved examples, three mixed ones and one undescribed gynandromorph with both sides *croceus.* A similar halved one was taken a few years ago in the Isle of Wight by F. W. J. Jackson. A coloured plate of a somatic mosaic with the left side *croceus* and the right side ab. *helice*, and of another with both fore-wings ab. *helice* and both hind-wings *croceus* has been published (1878, *Entomologist,* **11** : 40). A coloured figure of a third female mosaic with the left fore-wing ab. *helice* and the other three wings *croceus* is given by Mosley in '*Varieties of British Lepidoptera*' (*Colias*, pl. 2). Another halved example recorded by Hemming must be rejected. The pale side is probably due to a scale defect.

There are two gynandromorphs of *Colias erate* Esp., one with the right side male *erate* and the left side female ab. *pallida* Stgr., the other largely male, but with female parts ab. *pallida*. There is a mixed gynandromorph of *Colias myrmidone* Esp., with the left fore-wing male, the other three wings streaked with the sex-limited female colour of ab. *alba* Stgr., on the upperside, and entirely ab. *alba* on the underside. There is a halved gynandromorph of *Colias electo* L., with the right side male and the left side pale lemon colour, ab. *aurivillius* Kef. (1891, *Entomologist*, **24** : 216). A gynandromorph of *Colias lesbia* F., exactly divided into a left half, female and ab. *heliceoides* Capr., and a right half, male *lesbia* on the underside, but with some mixture of the two colours and sexes on the upperside is recorded (1921, *Ent. Rec.*, **39** : 97), and there is also a record by Jorgensen of one with both male and female parts typical.

Tockhorn mentions a gynandromorph of *Colias palaeno* O. with the male half yellow, f. *europome* Esp., and the female half white, though the female of *europome* is yellow like the male (1935, *Int. ent. Z.*, **29**).

In *Papilio glaucus* L., both a gynandromorph and a female mosaic are known and in each case one half is of the female sex-limited colour. Skinner records the gynandromorph, which has the left side male with the typical yellow ground-colour and the right side female with black ground-colour, *glaucus* L. (1919, *Ent. News*, **30** : 247). The mosaic has the left side black and the right side with yellow ground like the male, *turnus* L. (1884, Edwards, *Butts. N. Amer.*, **2** : pl. IV, fig. 4). Both probably originated from binucleate ova, but in one case one nucleus had a Z and the other a W-chromosome, and in the other each nucleus had a W-chromosome.

Although I do not know of any gynandromorphs of *Papilio polytes* L., a female mosaic has been recorded by Ollenbach with the right side *romulus* Cram., the sex-limited form which mimics *Pharmacophagus hector* L., and the left side *cyrus* F., the male-like form, with two streaks of the red colour of *romulus* in cell 4 (1930, *J. Bombay nat. Hist. Soc.*, **34** : 832, fig.).

(4) *Gynandromorphs showing in the male parts a climatic form different from that in the female parts.*

When the male and female parts of a gynandromorph differ in characters known to be influenced by temperature, humidity, or a combination of these two external factors, it is probable that the difference in response is due to an underlying genetic difference, and, if so, the gene or genes causing it are more likely to be autosomal than sex-linked. The evidence that such insects originate from binucleate ova is, however, not nearly so strong as in the classes mentioned above. Hale Carpenter records a halved gynandromorph of *Kallima inachus* Bdv., with the left side male and of the wet-season form, and the right side female and of the dry-season form (1934, *Proc. R. ent. Soc. Lond.*, **9** : 46). Frings in the course of a temperature experiment bred a gynandromorph of *Araschnia levana* L., with the right fore-wing male and of the form *prorsa* L., and the right hind-wing and both wings on the left side of the form *porima* Ochs. The brood was kept at a temperature of 40–41° C. and most of the imagines were of the form *prorsa* (1901, *Soc. Ent.*, **17** : 17).

Inherited Gynandromorphism.

It has been stated above that of two species with an inherited tendency to gynandromorphism one, *Argynnis paphia*, often has the female parts of the gynandromorphs showing a sex-limited character due to the combined action of a dominant autosomal gene and one in the W-chromosome, and the other, *Amorpha populi*, sometimes has the male and female parts of its gynandromorphs differing in somatic characters due to autosomal genes. It is therefore proved that an inherited tendency to produce binucleate ova exists in these species and causes the gynandromorphism. The occurrence in the same brood of more than one gynandromorph, showing different autosomal characters in its male and female parts, has been observed in *Hemerophila abruptaria*, *Ptychopoda seriata*, *Bombyx mori*, *Aglia tau*, and *Bistom betularia*, and indicates that in each case some of the ova of the female parent were binucleate.

It is a reasonable assumption that the occurrence of a familial or inherited tendency to gynandromorphism in species, which have no conspicuous mutant forms, is likewise due to binucleate ova, though both cytological and morphological proof is lacking. In *Eudia pavonia* L., mixed and halved gynandromorphs are comparatively common; more than 50 were recorded before 1911. There are two records of familial gynandromorphism in *pavonia*. In one brood from inbred stock there were three mixed gynandromorphs, one predominantly male and two predominantly female (1907, *Ent. Z.*, **20** : 241), and in another brood taken wild on a branch of *Salix aurita* near Wiesbaden there were five mixed gynandromorphs, one predominantly male, one predominantly female, and three, in which the male and female parts were about equal, and of five pupae, which died, three were gynandromorphs (Speyer, 1881, *Ent. Ztg.*, *Stettin*, **42** : 477).

Hereditary gynandromorphism also occurs in *Lymantria dispar* L. Goldschmidt and Fischer in 1914 bred two gynandromorphs of this species and breeding from the same stock obtained gynandromorphs in five successive generations. The broods were as follows—first generation, 150 males, 101 females, 2 mixed gynandromorphs; second generation, 81 males, 111 females, 13 gynandromorphs, 5 bilateral and 8 ‘ geviertelte ’; third generation, 91 males, 155 females, 9 gynandromorphs, 3 bilateral, 6 ‘ geviertelte ’; fourth generation, 61 males, 150 females, 21 gynandromorphs, 11 ‘ halbseitige,’ 10 ‘ geviertelte ’; fifth generation, 30 males, 50 females, 4 ‘ geviertelte ’ gynandromorphs. The evidence that these are derived from binucleate ova is much less satisfactory than in the case of *Amorpha populi* and *Argynnis paphia*, because in these are no conspicuous somatic characters, and the male and female parts can only show a simple sexual dimorphism. Some of these gynandromorphs are very similar to the intersexes obtained by crossing a male of a strong race with a female of a weak one, but in broods of this kind the intersexes replace the normal females, whereas in the broods containing gynandromorphs normal females occurred and in many cases exceeded the males in number. The species is one in which halved and mixed gynandromorphs are unusually common.

The most complete proof of the origin of mosaics and gynandromorphs from binucleate ova is that published by Goldschmidt and Katsuki. Katsuki found a recessive mutation in the larva, which gave the skin a translucent oily appearance, and showed that the gene was autosomal and not sex-linked as in the similar mutation bred by Tanaka. In some of his broods mosaic larvae appeared, with various arrangements of the normal and oily skin, and some of these produced gynandromorphs. In collaboration with Goldschmidt it was proved cytologically that females of this strain laid binucleate ova. Breeding experiments were carried out on a very large scale and hundreds of mosaic larvae and gynandromorphous imagines were bred. The great majority had one side oily and the other normal and, if they produced gynandromorphs, one side was male and the other female. In many, however, there was some crossing over of oily skin on to the normal side, and of normal skin on to the oily side. Sometimes, while one side was completely normal, normal skin spread over on to the oily side near the middle line, or vice versa. Dorso-ventral mosaics and gynandromorphs were fairly numerous, and the dorsal surface was either oily or normal, male or female. Crossed mosaics, normal on one side anteriorly and on the opposite side posteriorly and oily in the other two quarters, were rarer, and produced crossed gynandromorphs. Those with a complete mixture of the two larval characters and of the two sexes were the rarest of all.

Since mosaic larvae produced male and female imagines as well as gynandromorphs, and gynandromorphs were bred from normal larvae, it was evident that the sex-chromosomes of the two nuclei of the abnormal ova might be alike, either Z or W, or different, one nucleus having a Z and the other a W-chromosome.

A careful analysis of the results showed that the capacity to lay binucleate ova was determined by a single recessive autosomal gene. A female from a homozygous mosaic-producing stock will lay binucleate ova, and therefore when crossed with a male from a normal stock, will have mosaics amongst its progeny in the F1 generation. In the F2 generation, the females, heterozygous for the gene, which causes the production of binucleate ova, produce only normal ova and there are no mosaic offspring. Mosaics, however, appear again in the F3 generation, since those females homozygous for the gene lay binucleate ova. The reciprocal cross between a female of normal stock with a male of mosaic-producing stock gives normal larvae in the F1 generation, because in this case the female is laying ova with only one nucleus, and in the F2 generation the larvae are also normal, because both parents are heterozygous for the recessive gene, which determines the production of binucleate ova, but in the F3 generation mosaics appear. It will be seen, that, while the ratio of gynandromorphs to normal males and females should be constant, the ratio of mosaics to normal larvae will vary or mosaics will be absent altogether. If one parent is a male homozygous for the recessive gene for oily skin and the other parent is a female heterozygous for the same gene (ZZRR × ZWDR), sixteen combinations of the sex-chromosomes and the chromosomes with the autosomal gene for oily skin and its dominant allelomorph for normal skin are possible, if the ova all have two nuclei. The spermatozoa, however, will all be alike, ZR. The expected ratio is—4 gynandromorphs, 2 from oily larvae, 2 from normal larvae : 4 mosaic larvae producing gynandromorphs, 2 with the male side oily in the larval stage, and 2 with the female side oily : 4 mosaic larvae, 2 producing male and 2 producing female imagines : 2 normal larvae, 1 producing a male and the other a female : 2 oily larvae, 1 producing a male and the other a female. Actually mosaics are more delicate and the ratio of mosaics and gynandromorphs is often below that expected.

There are neither larval nor imaginal characters in *Lymantria dispar*, such as would lead to the recognition of somatic mosaics, but the percentage of gynandromorphs in the various broods is not unlike that found in *Bombyx mori*, and a recessive gene determining the production of binucleate ova may account for the gynandromorphism in this species also. There must, however, be a difference between the mode of inheritance of gynandromorphism in *Amorpha populi* and *Argynnis paphia* and that in *Bombyx mori*. In *populi* there are at least two conspicuous somatic characters, which must be determined by autosomal genes, in addition to the typical grey colour. These are the pink coloration of ab. *roseotincta* Reuter and the pale buff of ab. *pallida* Tutt. Both were present in Newman's strain and gynandromorphs, pink on both sides and pale buff on both sides, were bred. Pairings likely to produce gynandromorphs differing in their somatic characters must have been few, but as three such insects were bred there should have been both male and female somatic mosaics in the same brood or broods, and there were none. Somatic mosaics should have occurred from time to time in other strains, but, so far as I am aware, none have been recorded.

In the case of *Argynnis paphia* there should have been female mosaics, partly *paphia* and partly *valesina*, in some of Fischer's broods, in which mosaic gynandromorphs appeared, but there were none, and I know of no authentic record of a female mosaic having been captured or bred, though there are many records of mosaic gynandromorphs.

This absence of somatic mosaics in *populi* and *paphia* contrasts with their frequency in *Bombyx mori*, and must indicate some genetic difference. The production of binucleate ova in these two species may be due to a recessive gene, but, if females homozygous for it have all their eggs binucleate, there must be a selective death-rate; all those of *paphia* with a W-chromosome in each nucleus, and those of *populi* with a Z in each or with a W in each either fail to mature or the insects resulting from their fertilisation die before they become imagines.

REFERENCES.

GOLDSCHMIDT and FISCHER, 1927, *Arch. EntwMech.*, **109** : 1.
GOLDSCHMIDT and KATSUKI, 1927, *Zool. Jahrb.* (*Anat.*), **44**.
—— ——, 1927, *Biol. ZBl.*, **47** : 45.
—— ——, 1928, *Ibid.*, **48** : 39; 685.
—— ——, 1931, *Ibid.*, **51** : 58.
MORGAN and BRIDGES, 1919, The Origin of Gynandromorphs, *Publ. Carnegie Inst. Washington*, **278**.

THE TIMES OF ACTIVITY OF CERTAIN NOCTURNAL INSECTS, CHIEFLY LEPIDOPTERA, AS INDICATED BY A LIGHT-TRAP

By C. B. Williams, Sc.D.

(Chief Entomologist, Rothamsted Experimental Station, Harpenden.)

[Read 1st May, 1935.]

With Plates XV and XVI, Eighteen Tables, and Nine Text-figures.

Contents.

	PAGE
Introductory	523
Historical Survey	524
Description of the trap	525
The working of the trap	527
Sources of error	529
Interpretation of the results	529
Night Distribution of all Insects	530
Annual and monthly totals; comparison of actual numbers and logarithms	530
Comparison of distribution on good and poor nights	533
Night Distribution of certain Orders and Families	536
Diptera	536
Lepidoptera	537
Other Orders and Families	539
Night Distribution of certain Species of Lepidoptera	541
Distribution of single species	541
Difference in distribution of sexes	548
Difference in distribution of successive broods	550
Summary of the distribution in the Lepidoptera	550
Distribution of Species of Diptera	552
General Discussion	553
Summary	554
References	555

Introductory.

In the autumn of 1932 experiments were started at Rothamsted Experimental Station to try to correlate the activity of nocturnal insects with climatic and weather conditions. In order to get a regular estimate of the numbers of insects flying, free from personal error, a light-trap was used and the response of positively phototropic insects was made the basis of activity measurement.

At an early stage in the investigations it was realised that the insects found in the trap in the morning might have come in at any time in the night, and that a large catch might mean specially favourable weather conditions either at dusk, or at midnight, or at dawn. In order, therefore, to get more exact information on this point a mechanism was designed by means of which a series of eight killing bottles moved automatically under the trap during the night, so that within much narrower limits the time that various insects entered could be fixed. This mechanism was first put into regular action on 1st March, 1933, and has been working practically continuously for two years. From the figures so obtained it is possible to determine the time of activity during the night of many species, in so far as this activity is measured by their attraction to light.

Historical Survey.

Light-traps have been used for many years by amateur entomologists for the purpose of collecting specimens, and all regular users of the method know that many insects have special times at which they appear; but so far as I am aware, no systematic and continued investigation of this problem has yet been carried out.

In the economic field light-traps have been used for the destruction of certain pests, but with conflicting results as regards control; partly owing to the miscellaneous nature of the catch, including both useful and injurious insects; and partly owing to the fact that in many insects the males are more strongly phototropic than the females, so that the catch contains very few of the latter. In addition to this so little is known about the time of flight of the species concerned that the traps are often kept burning, with consequent increase of the already somewhat high cost, during periods when the insects are not active.

In Trinidad in the British West Indies, in July 1918, the present writer exposed a light-trap for successive hours during one night during a heavy infestation of the injurious sugar-cane Froghopper (*Tomaspis saccharina*) and obtained the following results :—

P.M.						A.M.				
7–8 :	8–9 :	9–10 :	10–11 :	11–12 :	12–1 :	1–2 :	2–3 :	3–4 :	4–5 :	5–6
4300,	3800,	3050,	1800,	1550,	1475,	1125,	900	850	620,	450.

It will be seen that over one-half of the total catch was in the first three hours of the night, and that the numbers fell steadily from dusk to dawn, being at the latter period one-tenth of the figures at dusk.

In investigations on the Pink Boll Worm of Cotton (*Platyedra gossypiella*) several observations have been made on the time of activity.

Ballou (1920 : 24) separated the catches made in a light-trap in the room of an insectary in Egypt in October 1916 into hourly catches from 5 p.m. to 9 p.m. and then the remainder of the night together. The result of four nights on this system was

5–6 :	6–7 :	7–8 :	8–9 :	rest of night.
0	2418,	352,	123,	270.

Delassus (1931) referring to investigations in Algeria, said on the contrary that the numbers of this moth captured at dawn were often greater than at dusk, but gave no figures.

Husain, Khan and Ram (1934) in experiments on *P. gossypiella* in the Punjab divided the night into three periods of four hours each, namely 6–10 p.m.; 10 p.m.–2 a.m.; and 2–6 a.m. Trapping was carried out in September and October in each of the three years 1929–1931. In 1929 and 1931 the results showed maximum flight in the last period at the beginning of the experiment, in the midnight period at the middle of the test and in the early portion of the night towards the end. In 1930 the maxima occurred in the middle period in the first half of the experiment and in most of the second half, with, however, maxima in the first period on three nights during the second half.

An inspection of the results, together with the temperature figures which were given with them shows, however, that the temperatures were falling steadily during the period of observation each year and that whenever the maximum night temperature was over 95° F. or the minimum over 78° F. the maximum catch was always in the last third of the night; when the maximum was over 90° or the minimum over 70° the maximum catch was never in the first period; and when the maximum was under 88° or the minimum under 66° the maximum catch was always in the first period. Thus the changes in the distribution indicate a change in external conditions and not a change in the reactions of the insect, though it is obvious that we are dealing with an insect in which reaction to temperature is more important than any tendency to fly at a particular period of the night.

At the University of Minnesota in 1932 experiments were being made on the time of flight of certain Lamellicorn beetles, by using a series of simple light-traps lighted in sequence during the night. The trap has been described by Seamens and Gray (1934), but so far as I am aware no results obtained by its use have been published.

Description of the Trap.

The trap used in the present experiments is based, so far as the upper catching portion is concerned, on the trap originally made in Egypt about twelve years previously (Williams 1924) with the exception that a 200-watt electric light (*a*) is used instead of the glass globe and acetylene burner in the original model.

Pl. XV shows the complete trap and pl. XVI details of the construction of the bottle-changing mechanism. The photograph on pl. XV was taken in the first year before the mercury switch for turning on and off the electricity was in use, and when a transformer and barretter lamps were being used to stabilise the current (see below). The dimensions of the trap are: width 23 inches; height—to top of table 39 inches—to light 43 inches. The sides of the trap beneath the table top are normally closed by wooden shutters to prevent damage to the mechanism by rain, and to prevent light being visible below the table top.

Beneath the light the central glass chamber is closed by a zinc funnel (*b*) which leads to a cyanide killing bottle (*c*) made from a 1 lb. wide-necked honey jar of the Ministry of Agriculture standard pattern with no constriction at the neck. The size is approximately 2½ in. in diameter and 5½ in. high. Eight of these killing bottles stand in shallow grooves on a turntable (*d*) rotated by a small weight (*e*) attached to a string which passes over two pulleys and then round a series of screw pegs (*n*) beneath the turntable. The pulley nearest the weight is fixed to the main frame of the trap and the Meccano strip shown supporting it in pl. XVI is only a temporary fitment to allow the photograph to be taken. The wires round the upper portions of the killing bottles are counterpoises to bring them all to the same weight and so to allow free movement of the turntable.

The turntable is prevented from rotating by an escapement (*f*) which strikes against a series of eight pegs (*g*) projecting from the underside of the turntable. The escapement is in turn actuated by a series of pegs (*h*) movable in slits on a timing disc (*i*) rotated by clockwork once in 24 hours. The clock used is a standard one-day meteorological drum (*k*) with the timing adjusted to 24 hours, as the so called "one-day" drums actually take about 26 hours to rotate. There are seven pegs on the disc and as each one in turn strikes the escapement the turntable is released and allows one bottle to change to the next. The result is that the bottles can be automatically changed at any time during the night by fixing the positions of the pegs on the timing disc to the required times.

In practice the middle peg is fixed at midnight and the others arranged so as to divide into four equal parts the periods from half an hour after sunset to midnight, and from midnight to half an hour before sunrise respectively. The timing is altered once a week, on Mondays.

A second series of concentric holes in the timing disc, with two movable pegs, turns on the electricity at sunset and off at sunrise, by allowing a small mercury vacuum switch (1) to fall in two steps. The original position of the switch as it is set each day is " off," the second " on," and the third " off " again.

The whole bottle-changing mechanism is mounted on a stout base (*r*) resting on four adjustable legs (*s*), and just above the bottles is a flat top (*t*) to prevent the escape of insects and gas from the bottles not in use. This top is supported by four adjustable supports (*u*).

The actual time of exposure of each bottle is one-eighth of the night, counting from half an hour after sunset to half an hour before sunrise. The light is, however, turned on at sunset and off at sunrise so that bottles one and eight are exposed for half an hour longer than the others, but this is for all practical purposes daylight. The time of exposure of one bottle varies from about forty-five minutes at midsummer to about two hours in midwinter, as is seen in the following table.

TABLE 1.

Date.	On; sunset.	1–2.	2–3.	3–4.	4–5.	5–6.	6–7.	7–8.	Off; sunrise.	Mean duration.*
Jan. 1 .	3·59	6·21	8·14	10·7	12	1·55	3·50	5·45	8·8	1·54
Feb. 1 .	4·46	6·57	8·38	10·19	12	1·48	3·36	5·24	7·40	1·45
March 1 .	5·37	7·36	9·4	10·32	12	1·36	3·12	4·48	6·47	1·32
April 1 .	6·30	8·15	9·30	10·45	12	1·17	2·34	3·51	5·37	1·16
May 1 .	7·20	8·53	9·55	10·58	12	1·1	2·2	3·3	4·34	1·02
June 1 .	8·4	9·25	10·17	11·8	12	12·50	1·40	2·30	3·51	0·51
July 1 .	8·18	9·36	10·24	11·12	12	12·50	1·40	2·30	3·49	0·49
Aug. 1 .	7·48	9·14	10·9	11·5	12	12·59	1·58	2·57	4·25	0·58
Sept. 1 .	6·47	8·27	9·38	10·49	12	1·11	2·22	3·33	5·14	1·11
Oct. 1 .	5·38	7·36	9·04	10·32	12	1·23	2·46	4·09	6·2	1·25
Nov. 1 .	4·33	6·48	8·32	10·16	12	1·36	3·12	4·48	6·55	1·40
Dec. 1 .	3·53	6·18	8·12	10·06	12	1·49	3·38	5·27	7·45	1·52

Times of changing of bottles in light-trap and mean duration of bottle in each month. Greenwich mean time.

* Mean duration is excluding extra half-hour daylight in periods 1 and 8.

In the first year of working the trap was on a 100-volts circuit which was at times very much overloaded, with the result that the actual voltage at the lamp sometimes fell as low as 75 volts. As the light given out by a lamp varies approximately as the cube of the voltage, this was a serious matter, but it was eventually overcome by using a transformer (*m*) to step up the voltage from 90 to 180 and then inserting two barretter regulating lamps (*o*) (Phillips No. 1924) in parallel, in series with the lamp. Each of these allowed the passage of 1 ampère and reduced the voltage by 80, so that the final current was stabilised at exactly 2 ampères and about 100 volts. Tests showed that a variation of 10% in the main current was reduced by this method to 1% at the lamp. In the second year of working the current was changed to 240 volts and the circuit was no longer overloaded, so that the use of the barretters and transformer was discontinued.

Throughout the whole period a resistance (p) of about 700 ohms has been inserted in parallel with the lamp, thereby reducing the voltage by about 10%. This considerably prolongs the life of the lamp and prevents rapid deterioration in its efficiency. The actual light produced is in the neighbourhood of 300 candle-power.

The working of the Trap.

The trap was started in regular use on 1st March, 1933. In the first three months it was not lit up on eleven days. In July 1933 it failed on two nights, but from the 11th July, 1933 to the middle of January 1935 it only failed on one night—that of 1st Aug., 1934. In January 1935 it was badly damaged by a falling scaffold pole, but was repaired after a loss of only two nights.

On some nights, however, when the trap was illuminated and gave a figure for the total catch, the bottle-changing mechanism stuck and so the distribution throughout the night was not obtained. Hence these figures cannot be used for the purpose of this discussion. These failures of the changing mechanism were in general rare except in November 1934, when some unknown cause—probably warping—resulted in a failure on half the days in the month and was only overcome by considerable reconstruction.

The trap has been exposed in the fields of Rothamsted Experimental Station, in the Chiltern Hills, about 25 miles north of London, at an altitude of about 400 feet on a flinty clay soil overlying chalk. The trap has on the east side of it an arable field which has been under mangolds for many years, as one of the "Classical" Rothamsted experiments, and which is likely to remain so for some years. On the south of the trap is a tennis court, on the north is a small orchard and on the west a large pasture. It is therefore in a very stable position which is not likely to vary much in its vegetation from year to year.

In the 24 months from 1st March, 1933 to February 1935 there were 730 nights, on 713 of which the trap was illuminated and the night distribution was obtained on 634 of these. In the first twelve months (March 1933 to February 1934), 109,344 insects were captured on all nights when the trap was illuminated, and in the twelve months March 1934 to February 1935 the total was 103,362.

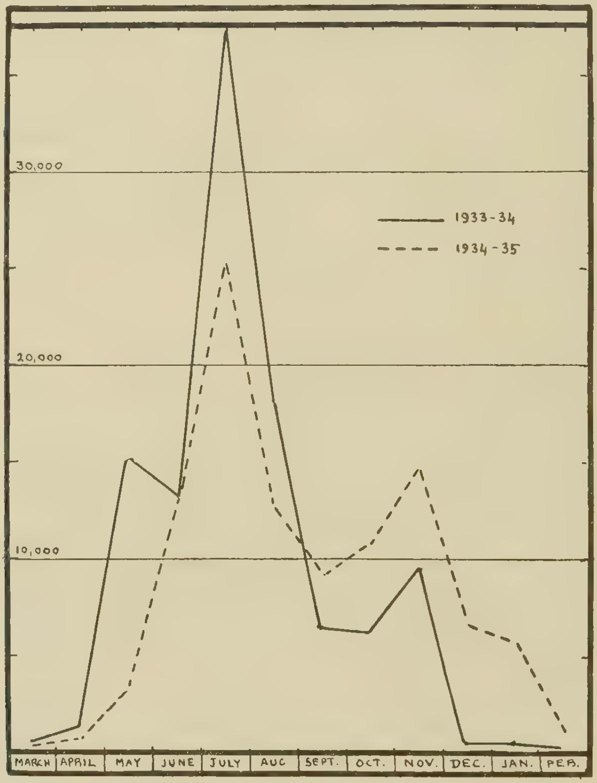
Table 2 and fig. 1 show the distribution of the catches throughout the differ-

TABLE 2.

	1933–34.	1934–35.	Differences 2nd–1st.
March . . .	518	232	— 286
April . . .	1,421	659	— 762
May . . .	15,368	3,118	—12,250
June . . .	13,141	13,139	— 2
July . . .	37,521	25,482	—12,039
August . . .	18,024	12,286	— 5,738
September . .	6,621	9,260	+ 2,639
October . . .	6,230	10,852	+ 4,622
November . .	9,412	14,872	+ 5,460
December . .	500	6,615	+ 6,115
January . . .	500	5,749	+ 5,749
February . .	88	1,195	+ 1,107

Distribution of catches of all insects in each month throughout the two years.

ent months of the two years. The great drought of 1933–1934 commenced to be serious about August 1933 and lasted for about a year. It is therefore interesting to note that all the months from September 1933 to August 1934 were below those corresponding months in the other year. This applies particularly to the Diptera as the Lepidoptera in July 1934 were above those of July 1933. It would appear that drought is therefore an important factor in the population question. This will be discussed in full in a later paper; at the moment it is only necessary to note that autumn insects tended to be more abundant in 1934 and spring and early summer insects more abundant in 1933.



1

Fig. 1.—Monthly total captures in the trap; March 1933 to February 1935.

The distribution of the total captures amongst the different orders of insects in the two years is shown in Table 3. It will be seen that the Diptera constitute the great majority of the catch in each year but that they were considerably fewer in the second year, while on the other hand the Lepidoptera were very considerably higher in 1934–5 than in 1933–4. Coleoptera, Psocoptera and Thysanoptera were all slightly more abundant in the second year. In fact, the whole of the total reduction in the second year is more than accounted for by the Diptera.

TABLE 3.

	1933–34.		1934–35.	
	Number.	%.	Number.	%.
Diptera	85,050	77·8	75,507	73·0
Lepidoptera	14,898	13·6	19,945	19·3
Rhynchota	5,699	5·21	5,163	5·0
Hymenoptera	2,495	2·28	1,186	1·1
Psocoptera	549	0·50	673	0·70
Coleoptera	439	0·40	651	0·63
Neuroptera	72	0·066	132	0·13
Trichoptera	65	0·059	40	0·04
Thysanoptera	50	0·046	141	0·14
Dermaptera	25	0·023	41	0·04
Ephemeroptera	2	0·002	1	0·001

Distribution of the catches in the two years among the different orders of insects.

Sources of Error.

The chief source of error in the trap is that due to the time taken for an insect to reach the killing bottle and to be finally overcome. Some insects settle on the outside of the trap and may stay there for a long period. If they do not eventually enter the trap they do not affect the results. Others get inside the trap but may fly around for some time before they are overcome. A watch kept on several nights showed, however, that most insects were lying on the bottom of the killing bottle well under five minutes from the time of entry, many indeed in less than two minutes. Diptera were most rapidly killed and Coleoptera least rapidly. The cyanide bottles must be recharged about once a month in order that they should be efficient, but actually the heat of the lamp is probably the major agent in causing the insects to fall into the bottle. As we are dealing with night periods of, at a minimum, forty-five minutes an error of five minutes is not serious. The error from these sources tends to make the apparent time of flight later than it should be.

The only source of error that could cause the distribution to appear earlier than the true arrangement would be that due to a very highly efficient trap working on a rather local and sedentary species. Under these conditions the individuals available might all be captured early in their flight period.

Interpretation of the Results.

With regard to the interpretation of the results it must clearly be understood that the captures in the trap measure only the phototropic activity of insects, and the times of flight mentioned below are those of response to a light. If flight activity can take place in these same insects without phototropic response, as is not impossible, then this flight will not be indicated. Steps are being taken to test this by working other types of trap, not dependent upon phototropic response, simultaneously with the light-trap.

The most serious difficulty of interpretation, particularly when captures of insects on different nights are being combined together, is that due to the swamping effect of one or two " good " nights over a large number of " poor " nights. Thus, if the distributions are different (as will be shown later on to be the case) the final result obtained will be determined largely by the nights with high catches, so long as the actual numbers are used. As an example of this effect, it may be pointed out that more insects were captured on the 1st January, 1935, than in the whole of the months of January, February, March and April 1934.

On the basis of the actual numbers also the difference between captures of 10 and 20 insects becomes of the same value as that between 1010 and 1020 which is very unlikely to be the case. From pure reasoning it is more probable that differences to be of the same significance should be in a geometrical ratio, so that 10% changes of number should be comparable over the whole range of captures. On this supposition the difference between 10 and 15 would be equivalent to that between 100 and 150 or 1000 and 1500. This geometrical ratio can be taken into account by using the logarithm of the number of insects captured instead of the numbers themselves.

As, however, the logarithm of zero is minus infinity it is necessary to add 1 to all figures of catches. Thus the log. number used to represent zero catch is zero; that for one insect is 0·3; for 9 insects is 1·0; for 99, 2·0 and for 999 is 3·0. In actual practice the adding of the unit to captures over 100 makes no significant difference. This method of using logarithms instead of the actual numbers has been tested in several ways and has proved to be statistically sound and has always given more consistent results than the actual numbers. Full details of some of the tests will be given in another publication.

It is most important to use the logarithm method when the figures dealt with vary greatly (for example, the total number of insects in a bottle varies from 0 to over 2000, and the total for a night varies from 0 to over 5000). It is, on the other hand, less necessary when the numbers only vary through a small range, as is the case when dealing with the distribution throughout the night of a single species of moth.

The use of logarithms tends to emphasise consistency of results as opposed to high variations. Thus by the use of logs. the capture of 9 insects on each of three successive nights has the same addition value as 999 insects on one night and nothing on each of the other two. In this way it overcomes the swamping effect of one large capture in a series. Some examples of the different results obtained by the two methods are given below in the section on the distribution of total insects which, as it deals with the largest numbers, is most likely to show the effect.

The logarithm results can be expressed as a total log. sum; or as a mean log. (the first figure divided by the number of nights under consideration); or as an actual figure of mean night catch, which is obtained by reconverting the mean log. to a number (anti-log.) and subtracting 1 from this to balance the original addition of 1 to each figure before taking the logs.

Night Distribution of all Insects.

(a) *Annual and Monthly Totals; Comparison of Actual Numbers and Logarithms.*

Tables 4 and 5 give a summary of the captures in each period of the night in the twenty-four months under review and also the totals and average night captures for each of the two years March to February. In Table 4 the actual numbers have been used as a basis for summation and in Table 5 the logarithms.

From Table 4 and fig. 2 it will be noted that in the first year the number of insects caught in the first two periods was practically identical (16,166 and

TABLE 4.

ALL INSECTS. ACTUAL NUMBERS.

Month.	No. of nights.	1.	2.	3.	4.	5.	6.	7.	8.
1933.									
March .	26	113	66	**147**	94	32	33	17	*16*
April .	27	**383**	188	129	114	186	120	169	*110*
May .	27	**4,907**	3,951	1,637	904	891	799	1,378	*254*
June .	27	**1,906**	1,849	1,612	1,428	1,729	1,657	1,083	*669*
July .	27	*2,957*	5,503	**6,809**	5,593	5,554	3,715	2,975	3,633
August .	25	**3,663**	2,552	3,084	1,887	1,678	1,550	*1,207*	1,258
Sept. .	25	951	497	*340*	460	599	722	793	**1,109**
Oct. .	29	611	597	*514*	782	**1,238**	1,065	842	547
Nov. .	28	*639*	817	842	**1,680**	1,547	1,269	1,620	657
Dec. .	31	20	**147**	94	60	53	41	51	*25*
1934.									
Jan. .	31	5	*2*	10	3	24	12	32	**412**
Feb. .	27	**11**	10	8	4	3	4	2	*1*
Total .	330	16,166	16,179	15,226	13,009	13,534	10,987	10,169	8,691
Average per night .	—	49·0	49·03	46·1	39·4	41·0	39·3	30·8	26·3
1934.									
March .	30	**51**	29	23	48	*19*	21	20	20
April .	26	104	93	61	*34*	*34*	43	37	**176**
May .	28	299	**639**	313	*149*	410	538	313	343
June .	23	**1,793**	1,340	1,211	1,140	1,071	731	*592*	706
July .	29	4,031	**4,066**	3,479	3,050	2,496	1,883	*1,759*	3,734
August .	29	**2,641**	2,276	1,640	1,326	*1,036*	1,149	1,129	1,302
Sept. .	24	**1,084**	841	625	627	450	*313*	315	464
Oct. .	26	1,261	472	*466*	883	**2,201**	1,265	1,655	1,458
Nov. .	14	**1,247**	838	928	978	875	736	715	*547*
Dec. .	26	**815**	479	795	705	689	735	776	*460*
1935.									
Jan. .	26	739	491	730	558	835	726	*349*	**1,345**
Feb. .	25	120	67	*27*	54	**664**	148	32	80
Total .	296	**14,185**	11,631	10,298	9,552	10,780	8,288	7,692	10,635
Average per night .	—	47·9	39·3	37·8	32·6	36·5	28·0	26·0	35·9

16,179). After this there is a more or less steady fall throughout the night to the last period which has just over half the total of the first or second (8,691). In the second year the first period (14,185) is definitely higher than the second, and again there is a steady fall to the seventh period (7,702) which is about half the first. In this year, however, the eighth period shows a very distinct rise (to 10,635) giving actually the third highest total of all the periods.

When the monthly numbers are examined it will be seen that the distribution varies considerably. In 1933–34 the maximum is in five months in the first period, once in the second, twice in the third, once in the fourth, once in the fifth, and twice in the eighth period. Similarly the monthly minimum has occurred in periods 1, 2, 3, 7, and 8. In 1934–35 the maximum is most often in the first period and the minimum never before the third, but still there is considerable variability. Some of the inconsistencies can, however, be easily explained: thus in January 1934, 427 out of a total for the month

TABLE 5.

ALL INSECTS (Log. $n + 1$).

Bottle.	1.	2.	3.	4.	5.	6.	7.	8.
1933.								
March	**11·5**	10·9	8·8	8·3	5·6	4·8	*3·3*	3·5
April	**19·6**	12·9	10·8	7·8	10·9	9·0	9·7	*7·4*
May	**44·8**	37·1	33·8	27·0	26·2	25·6	30·6	*17·9*
June	40·1	**41·4**	37·4	35·8	35·5	35·0	*27·5*	28·1
July	47·1	53·2	**54·0**	50·3	48·4	45·5	*42·6*	49·6
August	**44·3**	41·4	40·5	38·0	36·2	36·1	*30·3*	32·4
Sept.	**35·4**	29·8	*26·3*	28·6	28·4	29·0	29·0	28·8
Oct.	**28·2**	26·4	24·0	25·9	28·0	21·9	20·5	*18·9*
Nov.	23·8	25·1	*22·9*	27·1	**27·5**	25·0	26·3	23·0
Dec.	4·7	**9·1**	8·4	4·7	*3·4*	3·5	4·4	3·9
1934.								
Jan.	1·4	*0·6*	1·9	0·9	3·8	2·9	3·3	**4·5**
Feb.	**2·9**	1·8	1·7	1·4	0·5	0·9	0·5	*0·3*
Total Log.	303·8	289·6	270·6	255·8	254·4	239·2	227·9	218·3
Average log.	0·92	0·88	0·82	0·775	0·771	0·725	0·69	0·66
Average catch	7·3	6·7	5·6	5·0	4·9	4·3	3·9	3·6
1934.								
March	**7·7**	5·2	4·9	3·1	3·2	3·2	*1·9*	3·7
April	**10·8**	8·7	7·7	*4·4*	5·8	5·3	4·6	7·9
May	**23·4**	23·0	14·6	13·9	11·0	*10·8*	13·7	15·6
June	**36·1**	32·5	28·1	28·8	29·2	26·2	27·2	*25·5*
July	**57·6**	57·2	54·6	52·0	49·5	45·6	*44·7*	49·2
August	**61·4**	43·9	38·5	36·8	34·0	31·4	*29·3*	31·4
Sept.	**38·0**	28·4	24·5	25·1	22·9	21·2	*19·4*	21·2
Oct.	**30·1**	24·7	21·9	24·3	23·1	23·7	*20·5*	23·4
Nov.	**19·6**	16·5	16·6	16·4	16·6	15·6	*15·2*	*15·2*
Dec.	**27·8**	17·2	17·8	17·2	15·8	19·0	18·1	*12·1*
1935.								
Jan.	**19·3**	16·7	16·6	14·2	16·7	15·7	*9·0*	9·9
Feb.	**12·0**	7·4	4·5	5·1	6·1	6·5	*4·4*	6·0
Total log.	343·8	281·4	250·3	241·3	233·9	224·3	207·9	221·3
Average log.	1·161	0·951	0·846	0·822	0·790	0·758	0·702	0·748
Average catch	13·5	7·9	6·0	5·6	5·2	4·7	4·0	4·6

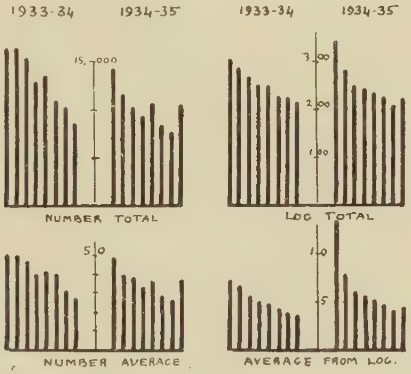
Maxima each month in **heavy type**, minima in *italics*.

of 500 insects were in the last two periods of the night of the 11th; while in October 1934 over half the month's total appeared on one night (the 7th) and chiefly after midnight. In both these cases the month's distribution has been strongly biased by a single exceptional night.

Table 5 shows the same results as in Table 4 but based on the sum of the logarithms of each night-period catch, which, as has been explained above, emphasises steady consistent effects and reduces the importance of isolated exceptional high variations. It will be seen at once how much more consistent the results become, in spite of the fact that the actual ratio between the first and last periods has remained practically the same as before. In the year's total and the night average for 1933–34 there is a steady fall from the first period to the last, the eighth giving an average just below 50% of the first. In 1934–35 there is a rather more rapid but steady fall from periods 1–7, followed by a slight rise to period 8, but this latter is not higher than any of the periods 1–6. This shows that the high figure shown by period 8 in this year when actual numbers were used was largely due to a few exceptional nights and not to a high consistent difference.

When the monthly figures are compared the regularity of the results is still more noticeable. In the year 1933–34 the maximum is now seven times in the first period, twice in the second, and once each in the third, fifth and eighth. The exceptional captures on the 11th January, 1934, have not been offset even by the use of logarithms. In 1934–35 the regularity is even more marked and the maximum is in the first period in every month. Similarly the minima are in nearly all months in the seventh or eighth period.

In brief the results show maximum numbers in the first period at dusk, falling steadily throughout the night to about half in the last period towards dawn, with some evidence that the second period may closely approach the first, and that the last may surpass the seventh. There is no evidence of any regular change of distribution at different times of the year.



2

Fig. 2.—Distribution of all insects captured in the trap in the different periods of the night in the two years, on number and logarithm basis.

The difference between the average per night of 49 for the first period in 1933–34 obtained from the actual numbers (Table 4) and the average of 7·3 per night obtained from the logs. (Table 5) (and similarly for the other periods also) is that the first is an arithmetic mean obtained from a large number of nights with numbers slightly below this figure and a few nights far above. The average 7·3 on the other hand is a geometric mean and the number of nights above this value is practically equal to the number of nights below.

(b) *Comparison of Distribution on Good and Poor Nights.*

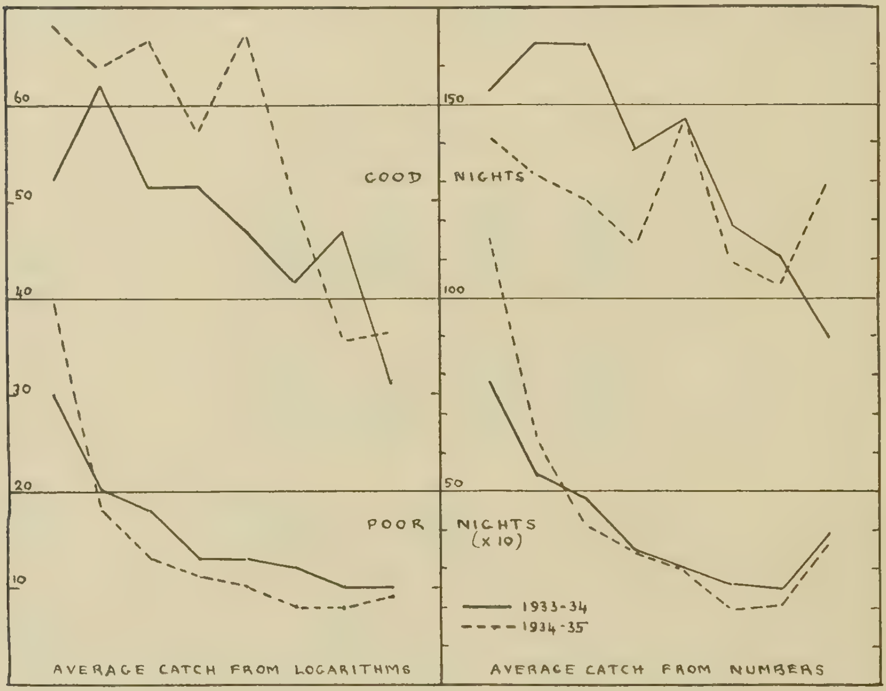
Although an examination of the night distribution of all insects shows no consistent difference between the different months, it was apparent after some experience that on the nights which had unusually large captures, the insects seemed to come later in the night, or rather kept up the numbers later, than on poor nights.

To test this the outstandingly good and poor nights in each month were selected and the captures in each period summed separately. The really bad nights on which no insects appeared (53 in 1933–34 and 17 in 1934–35) had of course to be left out of account. These figures were as usual treated both as actual numbers and as logarithms. The number of poor nights selected came to 126 in each of the two years. The good nights were 80 in 1933–34 and 60 in 1934–35.

Table 6 shows in detail the distribution of the log. summation for good and poor nights month by month in 1933–34, and the annual totals and average catch for logs. and actual numbers for both years. Fig. 3 shows the same results in graphical form, the poor nights being on ten times the scale of the good ones.

The following points may be noted :—

(1) There is a greater regularity of distribution in the poor nights each month in 1933–34 than on the good nights. This was even more strongly marked in 1934–35 for which the figures are not shown in detail.



3

Fig. 3.—Comparison of night distribution of all insects on good and poor nights.

(2) The annual totals show that on the poor nights there is a steady fall in numbers from the first period, which gives the highest catch. This fall is more rapid in the early half of the night and then the curve flattens out and there is slight evidence of a rise in the last period of both years. The last period gives from $\frac{1}{4}$–$\frac{1}{3}$ the numbers of the first period.

On the good nights the numbers remain much higher until about midnight; in fact in 1934–35 the captures in period 5 equalled those in the first period, when calculated either in number or log. basis. After midnight there

COMPARISON OF GOOD AND POOR NIGHTS BY LOGARITHMS AND NUMBERS.

TABLE 6.

	Poor									Good.								
	No. of nights.	1.	2.	3.	4.	5.	6.	7.	8.	No. of nights.	1.	2.	3.	4.	5.	6.	7.	8.
(1) Calculated from logs. :																		
1933–34.																		
March	12	**4·33**	3·16	3·18	1·68	1·74	0·30	0·30	1·38	4	3·04	3·81	1·86	**4·14**	2·38	3·07	1·20	0·30
April	12	**4·20**	1·20	1·86	0·90	0·90	1·08	1·38	0·30	9	**11·75**	9·64	7·23	5·87	8·44	6·13	7·87	6·63
May	11	**12·22**	7·84	7·03	5·20	5·60	5·40	6·49	2·86	10	**23·24**	21·58	19·32	17·14	15·30	14·58	17·17	9·39
June	8	**7·53**	7·20	6·25	5·68	4·87	5·64	3·36	2·93	6	12·89	12·92	12·16	12·57	12·26	**13·06**	11·93	10·48
July	10	12·78	12·91	**13·41**	10·06	9·14	9·47	8·41	13·39	13	26·48	32·29	**33·38**	32·50	32·40	29·83	28·78	29·79
Aug.	7	**7·83**	5·79	6·05	6·62	5·15	5·46	2·93	4·06	10	**22·85**	22·60	22·25	19·60	18·72	19·24	17·83	17·86
Sept.	8	**8·33**	8·30	6·22	6·55	6·30	5·56	5·37	5·38	8	13·45	11·03	10·50	11·81	12·84	13·65	14·22	**15·95**
Oct.	11	**6·82**	3·60	3·36	4·23	3·69	2·53	**2·53**	1·86	8	11·34	12·60	13·01	14·71	**15·77**	15·47	14·94	13·76
Nov.	8	3·46	3·32	1·63	2·06	2·68	**3·69**	2·93	1·75	8	11·30	13·01	13·89	15·38	14·03	12·79	**16·62**	12·82
Dec.	14	**3·95**	3·54	3·76	0·90	1·08	1·08	1·74	2·95	3	1·56	**4·56**	4·11	3·78	2·27	2·40	2·69	1·50
Jan.	14	1·38	0·60	1·93	0·90	**3·81**	2·94	1·86	1·93	1	0	0	0	0	0	0	1·42	**2·61**
Feb.	11	**2·16**	**2·16**	2·10	1·08	0·78	0·90	0·48	0·30	0	0	0	0	0	0	0	0	0
Total	126	**74·99**	59·62	56·78	45·86	45·77	44·05	*37·78*	39·08	80	137·90	**144·03**	137·71	137·50	134·41	130·22	134·67	*121·09*
Average log.		0·595	0·473	0·451	0·364	0·363	0·350	0·299	0·310		1·724	1·80	1·72	1·72	1·68	1·63	1·68	1·51
Average catch, 1933–34		**3·0**	2·0	1·8	1·3	1·3	1·2	*1·0*	1·0		52·0	**62·1**	51·5	51·5	46·9	41·7	46·9	*31·4*
ditto, 1934–35	(126)	**4·0**	1·8	1·3	1·1	1·0	*0·8*	0·8	0·9	(60)	**68·5**	63·7	66·8	57·2	67·6	50·3	*35·6*	36·4
(2) Averages calculated from actual numbers :																		
1933–34		**7·8**	5·4	4·8	3·5	3·0	2·6	*2·4*	3·9		153·9	166·2	**167·8**	138·6	145·4	118·7	111·2	*89·5*
1934–35		**11·6**	6·3	4·1	3·4	2·9	*1·9*	2·0	3·4		142·1	131·4	125·2	113·5	**145·2**	109·0	*103·4*	130·5

Maxima in **heavy type.**

is a more definite fall to a minimum of about $\frac{2}{3}$ the first-period numbers. This minimum is in period 8 in 1933–34 and in period 7 in 1934–35.

(3) The good nights in 1934–35 give a lower average on a number basis than in 1933–34, but a higher average on a log. basis. This is due to the fact that smaller numbers were more evenly divided among the nights, owing apparently to more regular weather conditions, and so give a higher geometric mean.

The causes of the difference in distribution will be discussed more fully in a later paper dealing with the relation of temperature to numbers. It may be briefly stated here, however, that the highest catches are associated with a high minimum and a flat temperature gradient from dusk to dawn, while the poorer nights have a steeper gradient. Thus when all insects are considered together, the distribution is very closely associated with the temperature gradients.

Distribution of Certain Orders and Families.

Diptera.

As the Diptera constitute about 75% of the total captures, it is to be expected that their distribution would largely determine the distribution of all insects. Table 7 and fig. 4 show that on both number and log. basis the Diptera show a steady fall from the first or second period to the seventh or eighth. In 1934–35 there is a significant rise from minimum in period 7 to period 8.

The greater smoothness of the log. curves is well shown in the comparison between these two results.

The principal groups of Diptera which were recognised in sorting are also shown on a number basis (unless otherwise stated) in Table 7. The Scatophagidae in 1933–34 showed a very definite first period maximum, though in small numbers, while in 1934–35 scarcely any of this family entered the trap.

In the Psychodidae, which were much more abundant in 1933–34 than in 1934–35, the first year shows the two first periods high and almost equal, and a steady fall to the last period. In 1934–35 the catches were more evenly distributed, but the first two were again the maximum while the minimum was in the seventh.

The Cecidomyidae show a somewhat similar type of distribution in each year, rising from the first period to a maximum about the third and then falling steadily till dawn, but in the first year the first period was very low, whereas in 1934–35 it was almost equal to the second.

The Mycetophilidae (chiefly *Sciara* spp.) show a remarkable difference in distribution in the two years. In 1933–34 there was a high maximum in period 1 and a rapid fall, while in 1934–35 captures were irregular, remained high throughout the night and the minimum in period 4 was followed by the maximum in period 5. An examination of the numbers shows, however, that in the second year out of a total of 5,727 Mycetophilidae 2,096 were captured in one night (the 7th October) with a distribution as follows: 102 : 112 : 71 : 112 : 743 : 231 : 436 : 289, which is definitely later than usual. The numbers were therefore recalculated on a log. basis, and the two years now show practically similar results falling from a maximum in the first or second period to a minimum in the sixth or seventh and rising again to the dawn.

The Chironomidae (excluding *Ceratopogon*) are very consistent and show

TABLE 7.

DIPTERA.

ALL DIPTERA	12,564	**13,184**	11,756	10,304	10,810	9,341	7,798	6,034
	11,193	8,221	6,571	6,657	8,224	6,956	5,433	7,647
ALL DIPTERA (log.)	**280·9**	264·4	242·1	226·3	216·8	219·9	194·3	187·2
	311·8	247·7	219·2	209·6	199·0	184·0	164·5	190·2
SCATOPHAGIDAE	**111**	38	24	41	21	19	19	11
	2	**6**	3	2	2	2	0	0
PSYCHODIDAE	4,108	**4,206**	2,357	1,829	2,540	2,355	1,891	906
	899	**1,067**	790	700	749	573	517	810
CECIDOMYIDAE	793	2,268	**3,567**	3,323	3,072	2,334	1,574	1,028
	1,419	**1,720**	1,627	1,664	1,183	1,073	796	743
CHIRONOMIDAE (excluding *Ceratopogon*)	**3,003**	1,313	669	387	382	302	359	1,009
	4,203	1,438	802	583	611	460	505	3,020
MYCETOPHILIDAE	**1,040**	514	183	92	84	66	61	68
	642	690	829	589	**1,167**	629	890	930
MYCETOPHILIDAE (log.)	46·4	**47·5**	30·3	16·6	12·7	10·3	7·4	11·1
	55·9	47·2	32·6	31·4	29·2	25·7	30·4	32·0
Ceratopogon	903	**2,231**	2,094	1,744	1,392	1,500	1,108	1,086
	584	551	589	446	**1,032**	936	762	702
BORBORIDAE	162	119	**224**	202	191	**223**	195	128
	872	481	500	764	845	391	345	296
TIPULIDAE (s. str.)	**216**	**215**	91	131	158	120	134	184
	208	116	62	73	35	36	57	84

Note.—In Tables 7–14 the first row of figures is the distribution in 1933–34 and the second row the distribution in 1934–35.

in each year a maximum in the first period, falling rapidly to a minimum after midnight and then rising again to a definite second maximum in the last period. In other words, the species tend to be dawn and dusk flyers.

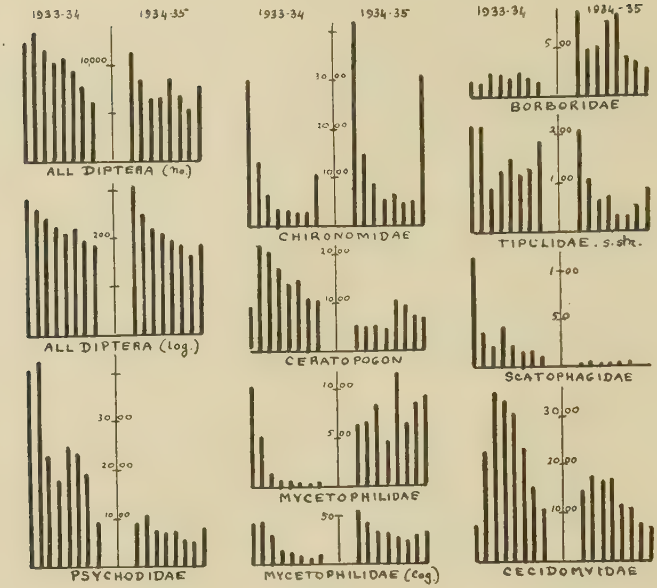
Ceratopogon showed in 1933–34 a low first period rising to a maximum in the second and falling steadily to the last, but in 1934–35 the numbers remained low until midnight and then rose slightly and fell again to dawn.

The BORBORIDAE on a number basis show no definite distribution in either year. They were much more abundant in the second year than in the first.

The TIPULIDAE show maxima in the first period and second maxima at dawn in both years thereby somewhat resembling the CHIRONOMIDAE.

Lepidoptera.

The figures for the total Lepidoptera and for the three chief families, NOCTUIDAE, GEOMETRIDAE and CRAMBIDAE are given in Table 8 and fig. 5.



4

FIG. 4.—Night distribution of different groups of Diptera.

TABLE 8.

LEPIDOPTERA.

Number.

ALL LEPIDOPTERA							
852	1821	2017	**2117**	1942	1682	1439	1667
1915	**3040**	2953	2675	2191	1630	1704	1817
NOCTUIDAE							
87	190	214	263	268	**284**	147	57
190	243	209	**278**	260	220	132	55
GEOMETRIDAE							
101	191	222	215	**233**	172	116	53
90	26	**144**	**144**	142	126	90	57
CRAMBIDAE							
173	696	855	**900**	570	411	238	200
1056	**1832**	1798	1376	1007	683	695	461

Logarithm.

ALL LEPIDOPTERA							
97·6	120·6	**128·9**	127·9	124·2	116·9	111·5	103·0
111·8	**125·1**	118·2	118·5	113·2	162·3	102·8	98·2
NOCTUIDAE							
17·8	36·8	42·8	46·4	48·5	**50·0**	30·7	15·0
33·4	43·3	41·4	**49·7**	47·5	40·7	29·1	13·2
GEOMETRIDAE							
21·1	34·8	**38·8**	36·6	37·6	31·1	22·0	11·7
17·7	25·0	**29·7**	28·1	27·9	25·7	19·0	12·9
CRAMBIDAE							
24·5	49·0	**57·3**	54·8	44·0	39·1	31·4	27·9
61·2	**76·4**	75·0	68·6	60·7	53·8	52·1	39·0

The Lepidoptera show a distinctly later distribution than the Diptera, with a maximum between the second and fourth periods and falling slowly. Actual numbers show a rise to the eighth period, but this is not shown in the logs. for the whole year. In the monthly figures, however (not given here), there is a slight rise in the logs. in July and August of each year.

In the families the Noctuidae are even later, giving maxima in the fourth to sixth periods, with a rapid fall from the sixth period to the last. The Geometridae are earlier, giving maxima in numbers in periods three to five, but on a log. basis the maxima in both years is in period three. The Crambidae show maxima in numbers in period four in 1933–34 and period two in 1934–35. On the log. basis these become periods three and two respectively.

It may be noted that in all these divisions 1934–35 tends to be about one period earlier than 1933–34.

Other Orders and Families.

Although the orders other than Diptera and Lepidoptera make up only a small proportion of the catch (about 8%), some of them come in sufficient numbers to show a definite and sometimes quite interesting distribution. (Table 9 and fig. 5.)

TABLE 9.

Other Orders.

Number.

Coleoptera							
215	62	46	30	19	15	12	22
301	91	46	35	31	36	30	21
Psocoptera							
283	49	45	44	44	29	19	25
305	88	37	54	32	27	42	37
Aphidae							
300	330	274	219	205	287	137	127
176	61	43	31	42	36	21	34
Cynipidae							
76	190	153	126	65	63	**357**	56
*	*	*	*	*	*	*	*
Jassidae							
1,245	247	114	76	67	77	75	309
749	137	76	61	51	40	63	483

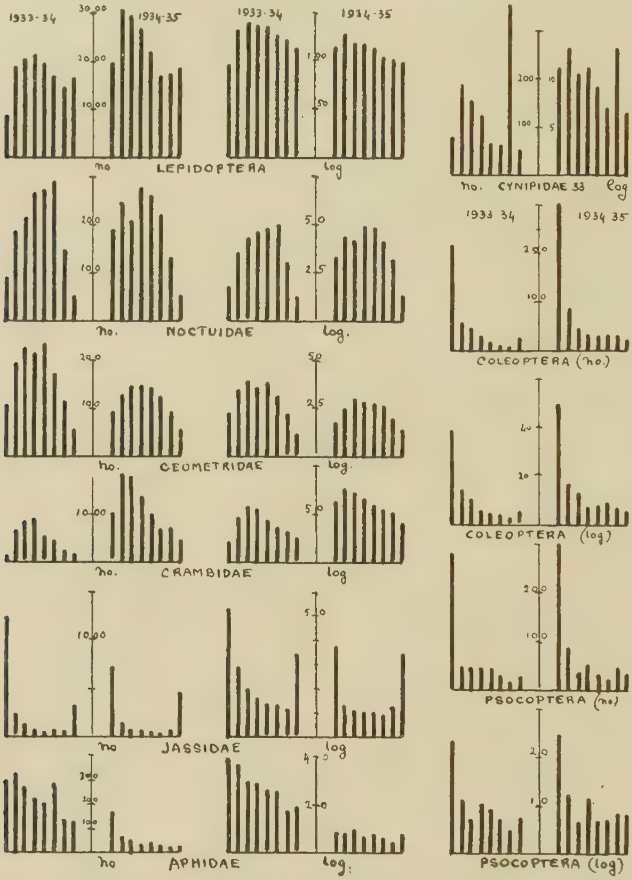
Logarithm.

Coleoptera							
35·6	15·3	10·2	5·7	4·6	4·1	3·3	5·3
50·0	16·7	13·4	7·6	8·3	8·6	7·4	5·2
Psocoptera							
23·1	11·2	7·3	10·2	9·1	7·0	4·9	7·8
25·0	19·9	6·4	11·2	6·9	6·5	8·2	8·2
Aphidae							
38·8	36·2	29·5	28·6	25·5	25·4	17·0	19·2
8·6	8·1	**9·2**	6·6	7·8	6·1	3·8	7·3
Cynipidae							
11·3	13·3	10·5	11·2	9·1	7·0	**13·4**	6·7
*	*	*	*	*	*	*	*
Jassidae							
54·5	24·0	16·0	12·5	9·7	9·1	7·8	30·3
34·3	13·2	11·5	10·5	11·1	9·8	12·4	31·7

The Coleoptera in both years and on both log. and number basis show a high maximum in the first period and a rapid fall during the night. 1933–34 shows a slight rise from period 7 to 8, but in the second year the fall continues.

The Psocoptera show a very definite maximum in the first period, a rapid fall to the second, and then low captures for the rest of the night with some evidence of a further fall as the night proceeds.

The Aphidae were much more numerous in 1933–34 than in 1934–35. In the first year they showed a more or less even fall from maximum in the first period to minimum in the last. In the second year the log. summation shows only a slight fall with the minimum in 7 and 8 nearly as high as 1. The actual numbers are much higher in period 1 than the others, but this is due to a particularly large catch on one night.



5

Fig. 5.—Night distribution of various groups of Lepidoptera, Rhynchota, Hymenoptera, Coleoptera and Psocoptera.

The Cynipidae came in fairly large numbers in May and June of 1933, but in the second year too few came to give any distribution. In 1933 there was a rise from the first to the second period and a steady fall after this to dawn, except for the seventh period which gave the maximum in both numbers and log. total. This was, however, due to an abnormal catch on the 16th May with 216 insects in this period.

The JASSIDAE give results somewhat similar to that just mentioned in the CHIRONOMIDAE. There appears to be a quite definite normal distribution in each of the two years, on both number and log. basis, with the maximum in the first period, small and decreasing catches in periods 2 to 6 or 7, and a rapid increase to the last period which is in 1934 almost comparable with the first period.

In each of the two years, however, there were single very large catches (in each case the largest of the year) which were quite abnormal. These two days are not included in the figures for the normal arrangement in Table 9.

On the 6th August 1933 there were over a thousand JASSIDAE caught of which 957 were in the third period (the species in this case *Cicadula sex-notata*); while on the 7th October 1934 about 600 were captured with maximum (388) in period 7 and 146 in period 8; in this latter case the species was *Empoasca* (*Chlorita*) *viridula*.

There appears therefore to be a distinct tendency for the nights of exceptionally large catches to have abnormal distributions in several of these groups of insects. In the case of the Jassids it was at first thought that there might be some connection between the abnormally large catches and migration, but we must await further evidence before this possibility can be discussed.

The Jassid figures on the log. basis give a regular distribution even including the two abnormal nights. The totals for the individual months (not given in full here) show a tendency for the period 1 maximum to be greatest in June, July and August and the period 8 maximum to be greatest in September and October. In all months, however, both maxima are distinct.

NIGHT DISTRIBUTION OF CERTAIN SPECIES OF LEPIDOPTERA.

Since species within a single genus or family may have different habits, and since the composition of catches in a single family may vary in the proportion of different species from year to year, the distribution of larger groups of insects which have so far been discussed have not the same interest as that of a single species.

The difficulty in obtaining information about single species is, however, twofold; first that few come in large enough numbers to give good distribution curves for one or two years only; and secondly that in order to cope with the necessary routine work, any species dealt with must be very easy to recognise. Those requiring dissection of the genitalia or very close examination before they can be separated from closely similar ones, are not suitable.

Among the various groups trapped, the larger Lepidoptera lend themselves most readily to this work and most of the results discussed below will relate to this group. The nomenclature for the Lepidoptera has been kindly checked for me by Mr. W. H. T. Tams of the British Museum.

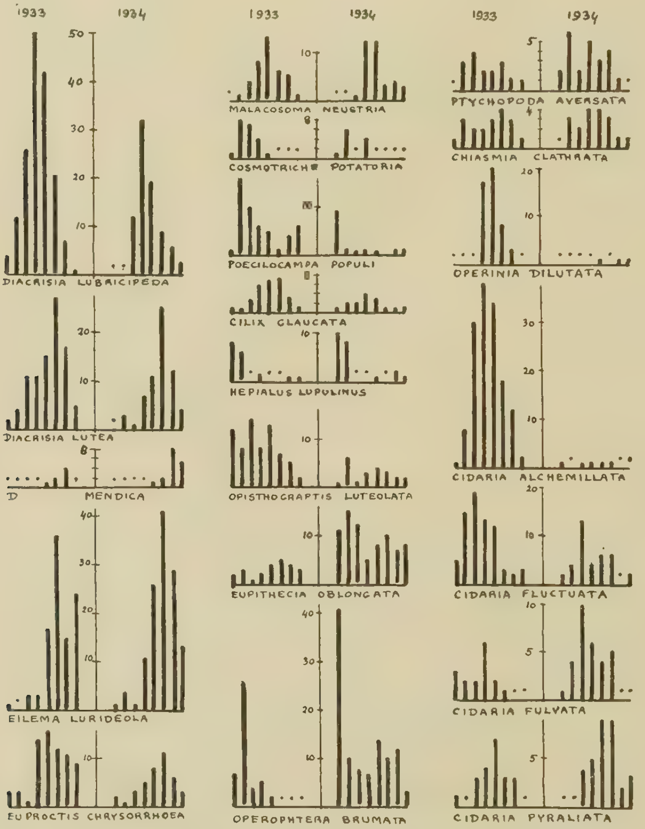
Distribution of Single Species.

Family CHELONIDAE. (Table 10 and fig. 6.)

Diacrisia lubricipeda (the White Ermine) shows an almost similar distribution in each of the two years with a maximum in the fourth period just before midnight. *D. lutea* (the Buff Ermine) also shows regularity in the two years, but with a maximum in the sixth period, about two periods later than *S.*

TABLE 10.

Cheloniidae								
Diacrisia lubricipeda								
	4	12	26	50	42	21	7	1
	0	0	12	32	19	9	6	2
Diacrisia lutea (Buff Ermine)								
	2	4	11	11	15	27	17	5
	0	3	1	7	11	25	12	2
Diaphora mendica								
	0	0	0	0	1	2	4	0
	0	0	0	0	0	2	8	5
Lithosiidae								
Eilema lurideola								
	1	2	3	3	17	36	15	22
	1	4	1	11	26	41	29	13
Liparidae								
Euproctis chrysorrhoea								
	3	3	1	14	16	12	11	9
	2	1	3	5	8	11	6	3
Bombycidae								
Malacosoma neustria								
	0	1	2	8	13	6	5	1
	0	0	1	12	12	3	4	2
Cosmotricha potatoria								
	1	8	7	4	1	0	0	0
	1	6	2	4	0	0	0	0
Poecilocampa populi								
	1	16	10	6	5	1	4	6
	9	1	1	1	1	0	1	1
Drepanidae								
Cilix glaucata								
	1	1	3	6	7	7	3.	1
	1	2	2	4	3	1	1	1
Hepialidae								
Hepialus lupulinus								
	8	6	0	0	0	0	1	1
	10	6	0	0	1	0	0	1



6

FIG. 6.—Night distribution of species of BOMBYCIDAE, GEOMETRIDAE, etc.

lubricipeda. *D. mendica* is an even later flyer and all the individuals captured came in after midnight.

Family LITHOSIDAE.

Eilema lurideola came in considerable numbers in both years with the great majority after midnight and the maximum flight in period 6 in each case.

Family LIPARIDAE.

Euproctis chrysorrhoea (the Gold Tail) is not common in the first two or three periods but then increases in numbers to periods 6 and 7. More than two-thirds of the captures were after midnight.

Family BOMBYCIDAE.

Malacosoma neustria is rare in the first three periods, reaches a maximum just after midnight and falls away to dawn. *Cosmotricha potatoria* is rare at dusk, reaches its maximum in the second period and has practically ceased to be attracted by midnight. *Poecilocampa populi* differs slightly in the two years having in 1933 the maximum in period 2, but fair numbers later, while in 1934 nine were captured in the first period and only single ones in any later period.

Family DREPANIDAE.

Cilix glaucata gives a smooth curve rising to a low maximum in the middle of the night in both years. The actual maximum was after midnight in 1933 and just before in 1934, but with such small numbers the similarity is as close as could be expected.

Family HEPIALIDAE.

Hepialus lupulinus only appeared in small numbers with practically all of them in periods 1 and 2 and only single individuals later.

Family NOCTUIDAE (s.l.). (Table 11 and fig. 7.)

Leucania conigera shows a very similar distribution in the two years with a maximum in period 5, just after midnight in both cases. *Leucania pallens* gives a rather indefinite distribution reaching its maximum in the middle of the night. *Leucania impura* has its maximum before midnight, in period 4 in 1933 and period 2 in 1934. *Parastichtis monoglypha* came only in very small numbers in 1933, but in 1934 gave a smooth distribution curve with maximum just before midnight.

Tholera popularis was much more abundant in the second year, but in each year gave a definite distribution with nearly all the captures in the first two periods.

Thalpophila matura (*cytherea*) reached its maximum in each year just after midnight. *Luperina testacea* is a later flyer with maximum in period 6 in both years, although much more numerous in 1934.

Trachea secalis gave very different results in the two years, but this was found to be due to varying sex proportion and will be discussed more fully below (p. 548).

Procus fasciuncula gave maxima in each year in the second period and no captures after midnight in 1933 or after period 6 in 1934. *Stygtostola tenebrosa* with the exception of two individuals only appeared in periods 4, 5, and 6 with a maximum in 5 in both years. It seems to have an unusually short activity period.

TABLE 11.

NOCTUAE.

Leucania conigera								
	1	1	1	3	**7**	3	3	0
	1	2	1	4	**8**	4	1	5
Leucania pallens								
	4	3	11	13	9	**17**	11	3
	7	3	4	**11**	9	9	0	4
Leucania impura								
	2	3	9	**14**	9	10	4	1
	3	**23**	15	8	7	0	5	4
Parastichtis monoglypha								
	3	3	2	3	2	**9**	2	1
	2	10	17	**20**	14	10	4	6
Tholera popularis								
	0	**15**	8	0	1	0	0	0
	37	45	6	6	3	3	1	2
Thalpophila matura (*Cytherea*)								
	1	2	7	6	**8**	6	2	3
	1	3	4	4	**8**	4	6	2
Luperina testacea								
	0	4	1	3	2	**18**	7	2
	5	17	15	25	27	**34**	18	3
Trachea secalis								
	3	4	5	3	8	**11**	2	3
	6	**9**	0	2	1	4	1	1
Procus fasciuncula								
	4	**9**	4	3	0	0	0	0
	5	**8**	3	5	6	3	0	0
Stygtostola tenebrosa								
	1	0	0	8	**13**	4	1	0
	0	0	0	6	**10**	4	0	0
Agrotis exclamationis								
	1	3	10	14	**30**	25	9	3
	2	8	11	29	**43**	28	19	5
Agrotis c-nigrum								
	3	10	12	**18**	5	7	5	2
	20	13	14	5	7	2	3	2
Agrotis festiva								
	0	2	2	**4**	2	3	**4**	0
	0	0	3	**5**	4	**5**	1	0
Agrotis rubi								
	1	8	**22**	20	7	5	2	1
	6	10	30	**33**	7	5	2	0
Agrotis xanthographa								
	45	**55**	29	18	11	8	6	6
	48	23	7	13	9	4	1	1
Monima gothica								
	0	8	9	7	**11**	**11**	3	3
	0	1	0	1	5	6	**16**	5
Amathes lychnidis								
	4	10	40	**82**	75	80	34	4
	10	17	26	**32**	24	15	9	5
Amathes lunosa								
	4	3	3	5	12	**17**	11	3
	4	1	1	9	26	**36**	20	2

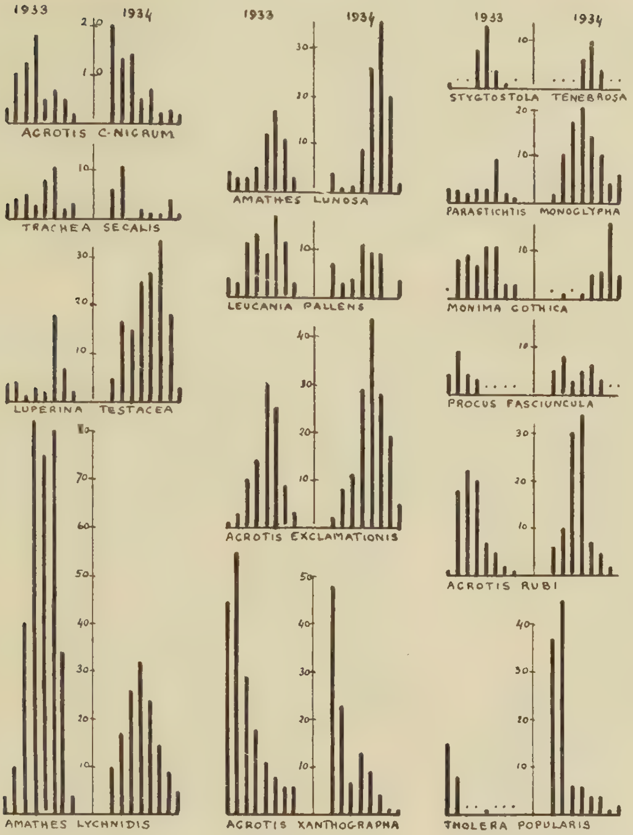
Agrotis exclamationis gives a very definite and smooth curve, practically identical in each year with the maximum just after midnight. *A. c-nigrum* shows rather different results in the two years, as although in both cases the majority fly before midnight, the maximum flight in 1933 is in period 4 while in 1934 it is in period 1. *A. festiva* gives no captures in either periods 1 or 8 either year, but otherwise rather irregular results on small total numbers. *A. rubi* gives quite definite and almost similar distribution with maximum in periods 3 and 4 and few captures after midnight. *A. xanthographa* gives also very definite and similar results, with maxima in the first two periods and a rapid fall throughout the rest of the night.

Monima gothica, a spring moth, gives rather different results in the two years, 1933 giving a flat-topped curve with a fair proportion before midnight and maximum in periods 5 and 6, while in 1934 there are very few before midnight and maximum in period 7.

Amathes lychnidis which is one of the most abundant of the NOCTUIDAE in the trap, gave maxima in period 4 in both years, but a rather more rapid fall to dawn in 1934 than in 1933. *A. lunosa* is a definitely late flyer with only small numbers before midnight and distinct maxima in period 6 in both years.

Family GEOMETRIDAE. (Table 12.)

In the GEOMETRIDAE as indicated in Table 12 and fig. 6 the results are disappointing as so few species came in any numbers in both years. In most cases, however, where there is a definite maxima in each year, it occurs in the same or a near period. *Opisthograptis luteolata* has maxima in periods 3 and 2; *Chiasmia clathrata* in 7 and 5–6; *Operophtera brumata* in 2 and 1; *Cidaria fluctuata* in 4 and 4; *Cidaria fulvata* in 4 and 3; and *Cidaria pyraliata* in 5 and



7

FIG. 7.—Night distribution of species of NOCTUIDAE.

TABLE 12.

GEOMETRIDAE.

Opisthograptis luteolata									*Oporinia dilutata*							
12	8	**14**	8	13	7	5	0		0	0	0	17	**20**	8	3	0
1	**6**	1	3	4	3	2	2		0	0	0	0	1	0	1	1
Ptychopoda aversata									*Cidaria alchemillata*							
0	3	**4**	2	2	**4**	1	1		1	8	30	**38**	34	18	12	2
2	**6**	2	5	3	4	1	0		1	0	1	1	1	1	0	0
Chiasmia clathrata									*Eupithecia oblongata*							
1	3	2	2	3	**4**	3	1		2	3	1	2	4	5	4	3
0	3	2	4	4	3	1	1		11	**15**	12	5	8	10	7	8
Abraxas grossulariata									*Cidaria fluctuata*							
0	4	2	**9**	4	8	5	1		5	15	**19**	13	12	3	2	3
0	1	3	2	1	3	**4**	1		2	4	**13**	4	6	6	0	2
Alsophila aescularia									*Cidaria fulvata*							
2	**6**	4	3	4	0	2	0		3	2	2	**6**	2	1	0	0
0	1	1	2	1	2	0	1		1	3	**10**	6	4	5	0	0
Operophtera brumata									*Cidaria pyraliata*							
7	**26**	4	5	2	0	0	0		1	0	3	4	**7**	3	3	0
41	10	8	7	14	10	12	3		0	0	4	5	**9**	**9**	2	3
Cidaria unidentaria									*Cidaria ferrugata*							
16	23	**37**	30	27	18	15	8		17	17	**20**	13	8	8	12	7
5	8	**12**	**12**	5	3	2	1		1	4	1	**6**	2	4	1	0

5 6 in the first and second years respectively. *Cidaria unidentaria* showed its maximum flight in period 3 in 1933 and in periods 3–4 in 1934, while the closely related *C. ferrugata* gave corresponding maxima in periods 3 and 4. *Oporinia dilutata* gave a definite maximum in 1933 in period 5, and *Cidaria alchemillata* in period 4 in the same year, but neither of these species turned up again in the following year in numbers large enough to give any significant distribution.

Differences in the position of maximum flight in the two years is seen in *Eupitheca oblongata*, *Abraxas grossulariata*, and *Ptychopoda aversata*, but in each case the numbers are too small to preclude the possibility of error.

Family PYRALIDAE. (Table 13 and fig. 8.)

Five species came in sufficient numbers to show the night distribution and of these four gave more or less similar results in the two years. *Pyralis costalis* gave the maximum in the second period with the third almost equal and the minimum in period 8 in both years. *Hapalia lutealis* is a late flyer with maximum in periods 7 or 8. *Sylepta ruralis* shows maximum in period 6 in 1933 and period 3 in 1934, though in 1933 period 4 was only one insect less than period 6. *Loxostege verticalis* has its maximum in periods 3 or 4, and *Evergestis forficalis* in 6 or 7.

TABLE 13.

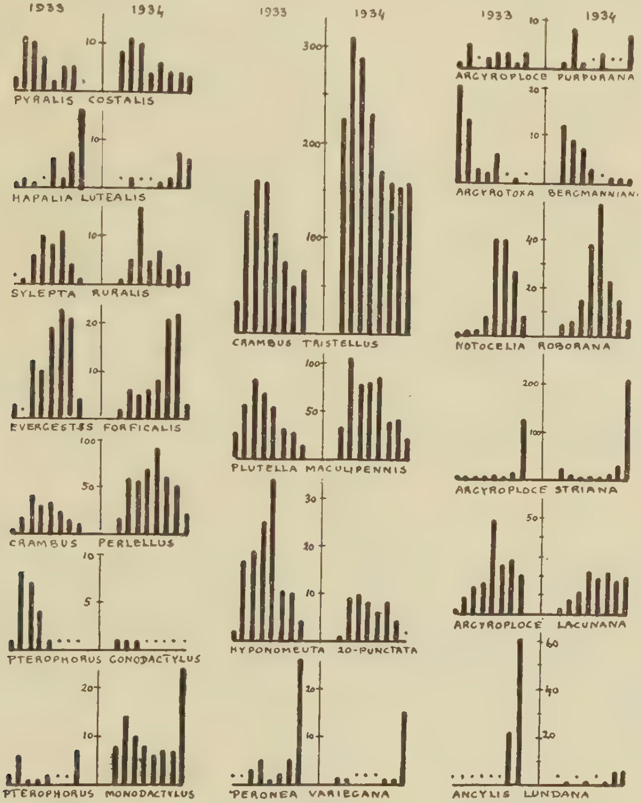
PYRALIDAE								
Pyralis costalis								
	3	**11**	10	7	2	5	5	0
	8	**11**	10	4	6	4	4	3
Hapalia lutealis								
	1	2	1	0	6	2	7	**16**
	0	2	0	0	1	2	**7**	6
Sylepta ruralis								
	0	1	6	10	8	**11**	4	1
	1	5	**16**	5	7	3	4	3
Loxostege verticalis								
	1	0	2	**5**	1	2	4	1
	1	3	**6**	3	5	1	0	0
Evergestis forficalis								
	3	0	12	10	19	**23**	21	4
	2	6	5	6	8	21	**22**	3
PTEROPHORIDAE								
Platyptilia pallidactyla Haw.								
	0	2	1	**4**	2	0	0	1
	0	0	**5**	3	2	0	0	0
Pterophorus gonodactylus Linn.								
	1	**8**	7	4	1	0	0	0
	1	1	1	0	0	0	0	0
PTEROPHORIDAE								
Pterophorus monodactylus Linn.								
	2	**6**	1	1	2	0	0	**7**
	8	**14**	10	8	6	7	7	**24**
CRAMBIDAE								
Crambus tristellus								
	32	127	**160**	158	103	74	49	67
	225	**309**	288	230	170	158	152	159
Crambus perlellus Scop.								
	4	19	**40**	30	33	24	15	11
	17	59	56	69	**90**	60	51	22
Crambus pratellus Linn.								
	2	6	9	13	9	**19**	3	2
	0	1	0	0	1	0	0	0
TINEIDAE								
Plutella maculipennis Curt.								
	27	58	**82**	67	53	30	27	14
	31	**109**	77	80	86	39	40	20
Hyponomeuta 20-punctata Retz.								
	2	17	19	25	**34**	10	10	4
	1	9	**10**	8	6	8	4	0
Carcina quercana Fabr.								
	4	**9**	3	2	4	2	0	2
	2	**9**	4	8	3	2	0	2

Family PTEROPHORIDAE.

With the exception of *Pterophorus monodactylus* L. the plumes only appeared in small numbers. *Platyptilia pallidactyla* Haw. (*bertrami* Ross) shows maxima in 4 and 3 in the two years. *Pterophorus gonodactylus* L. is an early flyer and shows a slight maximum in periods 2 and 3 in 1933, but only three specimens were captured in 1934. In 1933 only one was captured after midnight and in 1934 none. *P. monodactylus*, however, gives a very curious distribution, similar in each year, with a first maximum flight in period 2 and a second higher maximum in the last period. Several other insects have shown maxima in periods 1 and 8, but no others like *P. monodactylus.*

Family Crambidae.

Crambus tristellus was the most abundant species of Lepidoptera captured, especially in 1934. It shows an early maximum in periods 2 or 3. There is a slight rise in each year from periods 7–8. *Crambus perlellus* Scop., rises from a minimum in period 1 to a maximum in period 3 in 1933 or 5 in 1934 and then falls away again to dawn. *C. pratellus* L., gave a maximum in period 6 in 1933, but was very rare in 1934, only two specimens being captured.



8

Fig. 8.—Night distribution of species of Pyralidae, Crambidae, Pterophoridae, Tineidae and Tortricidae.

Family Tortricidae. (Table 14 and fig. 8.)

Many species of Tortricidae were captured, but only those that could be identified rapidly and with certainty could be used for this study. Perhaps the most interesting point in this family is the presence of three species which are very definitely late flyers. *Peronea variegana* Schiff., in both years has a very definite maximum in period 8. *Argyroploce striana* Schiff., shows the same thing

TABLE 14.

TORTRICIDAE.

Tortrix viridana Linn.								
	0	1	0	4	5	2	2	0
	2	0	0	2	4	0	0	0
Peronea variegana Schiff.								
	0	0	3	5	1	2	5	**26**
	1	1	0	0	0	1	1	**15**
Argyrotoxa bergmanniana Linn.								
	20	13	3	2	6	0	1	0
	12	9	7	3	0	1	1	1
Argyroploce variegana Hübn.								
	5	3	8	9	**12**	9	8	7
	4	**17**	7	9	7	5	5	8
Notocelia roborana Treits.								
	1	2	2	8	**40**	**40**	27	8
	5	6	15	38	**55**	23	15	7
Argyroploce purpurana Haw.								
	1	5	0	2	3	3	1	3
	1	8	1	0	3	0	0	7
Argyroploce striana Schiff.								
	4	4	3	3	6	4	17	126
	21	6	3	5	3	10	30	**204**
Argyroploce lacunana Dup.								
	2	8	14	16	**48**	25	28	20
	3	7	11	**22**	19	**22**	17	19
Ancylis lundana Fabr.								
	0	0	0	0	0	0	22	**61**
	0	1	0	1	0	1	**6**	**6**
Euxanthis hamana Linn.								
	4	**15**	10	10	1	2	1	0
	22	**22**	20	12	6	1	0	2

even more markedly, with, however, a sub-maximum in period 1 in 1934. In *Ancylis lundana* Fabr., the definiteness of flight period is very striking as in 1933 out of 83 individuals not one was captured before period 7. In 1934 periods 7 and 8 had most, but there were a few earlier captures.

Among the other TORTRICIDAE *Argyrotoxa bergmanniana* L., *Argyroploce purpurana* Haw., and *Euxanthis hamana* L., are early flyers with maxima in periods 1 and 2, while *Tortrix viridana* L., *Notocelia roborana* Treits., and *Argyroploce lacunana* Dup., reach their maximum just after midnight. *Argyroploce variegana* Hubn., is the only species with inconsistent results in the two years. It showed a maximum in period 5 in 1933 and in period 2 in 1934.

Family TINEIDAE s.l. (Table 13.)

Many species of this family came to the trap but most were too difficult to identify. Of those species identified that came in any numbers the most important was *Plutella maculipennis* Curt., which appeared in a succession of broods through the year. It showed definite maxima in period 3 in 1933 and in period 2 in 1934. *Hyponomeuta viginti-punctata* Retz., showed a definite maximum in period 5 in 1933 and a rather indefinite one rather earlier in 1934, but with much smaller numbers. *Carcina quercana* Fabr., showed its maximum flight in period 2 in both years.

Difference in Distribution of Sexes.

The majority of the larger Lepidoptera, as will be discussed more fully in a later paper, come to the light trap chiefly in the male sex. In some species only males appear. In a few cases, however, the proportion of females is moderately high and occasionally equal to the males. Most of the GEOMETRIDAE and the smaller Lepidoptera were not sexed owing to the difficulty of doing so rapidly.

Table 15 shows the distribution of the two sexes in seven species of NOCTUIDAE and two species of GEOMETRIDAE in which females came in fair numbers. The most striking difference is found in the case of *Trachea secalis*, in which species in each of the two years not a single male has appeared in the trap before midnight, and only an occasional female after midnight (one in 1933 and 3 in 1934). The other species show no such obvious difference in distribution, but it will be seen that on considering the totals for the two years before and after midnight (the last two columns in Table 15), there is a

TABLE 15.

DIFFERENT SEXES.

	1933.								1934.								1933 & 1934.	
																	Before midnight.	After midnight.
Anchocelis lychnidis																		
♂	2	3	19	59	66	70	29	4	3	11	20	28	15	13	7	2	144	206
♀	1	5	7	11	6	7	1	0	7	6	6	4	9	2	2	3	47	30
Agrotis exclamationis																		
♂	1	3	9	11	27	22	6	3	0	7	11	26	38	23	17	2	68	138
♀	0	0	1	1	1	1	0	0	2	1	0	3	5	3	2	3	8	15
Xylophasia monoglypha																		
♂	2	0	1	2	3	8	1	1	1	4	13	15	13	9	4	5	38	44
♀	1	3	1	1	0	1	1	0	0	5	4	5	1	1	0	1	20	5
Noctua c-nigrum																		
♂	0	5	8	3	2	5	3	1	15	10	12	4	4	2	2	1	57	20
♀	2	3	2	5	3	1	2	0	5	3	2	2	3	0	1	1	24	11
Leucania pallens																		
♂	1	2	8	6	7	13	9	3	3	1	1	11	5	8	0	0	33	45
♀	2	2	0	6	1	3	1	0	4	2	3	0	4	1	0	4	19	14
Noctua xanthographa																		
♂	41	48	28	15	18	48	2	5	46	21	7	12	9	4	1	0	218	40
♀	6	5	1	1	0	0	1	1	4	2	0	0	0	0	0	1	19	3
Apamea secalis																		
♂	0	0	0	0	5	5	2	2	0	0	0	0	1	2	1	0	0	18
♀	2	5	1	2	0	0	0	1	6	9	0	2	0	2	0	1	27	4
Cidaria unidentaria																		
♂	11	20	22	15	23	14	14	8	2	4	10	7	3	3	2	1	91	68
♀	15	3	15	15	4	4	1	0	3	4	2	5	2	0	0	0	51	11
Cidaria ferrugata																		
♂	17	13	17	10	8	8	11	5	1	3	1	5	2	4	1	0	67	39
♀	0	4	3	3	0	0	1	2	0	1	0	1	0	0	0	0	12	3

distinct tendency for the females to appear earlier in the Noctuids *A. lychnidis*, *P. monoglypha* and *L. pallens*, and in the two Geometers *C. unidentaria* and *C. ferrugata*. The other three species of Noctuidae, *A. exclamationis*, *A. c-nigrum* and *A. xanthographa* show no apparent difference in distribution between the two sexes.

It is curious to note that these English results correspond with some published by Kaburaki and Kameto (1929), who found that in Japan the females of the Rice Borer Moth (*Chilo simplex*) were in a majority an hour or two after sunset while the males did not predominate till after midnight. They state that the attraction reaches a high rate in the females at about the time mating and egg laying begin, and in the males at about the time that mating is over.

Difference in Distribution of Successive Broods.

Only four species of double-brooded Lepidoptera came into the trap in sufficient numbers in both broods to make separate distribution figures possible. Two of these were Noctuidae and two Geometridae. The figures obtained are shown in Table 16.

TABLE 16.

Different Broods.

	First Brood.								Second Brood.							
Noctua rubi																
1933	1	11	11	11	1	3	1	0	0	7	11	9	6	2	1	1
1934	0	0	7	3	1	0	1	0	6	13	23	29	7	4	2	0
1933 & 34	1	11	**18**	14	2	3	2	0	6	20	34	**38**	13	6	3	0
Leucania pallens																
1933	1	0	1	0	0	1	1	1	3	3	10	13	9	16	10	2
1934	0	2	0	7	6	7	0	1	7	1	4	4	3	2	0	3
1933 & 34	1	2	1	7	6	**8**	1	2	10	4	14	17	12	**18**	10	5
Cidaria unidentaria																
1933	13	10	7	0	0	0	1	1	3	10	30	30	27	18	14	7
1934	1	2	6	2	3	1	1	0	4	6	6	10	2	2	1	1
1933 & 34	**14**	13	13	2	3	1	2	1	7	16	36	**40**	29	20	15	8
Cidaria ferrugata																
1933	14	6	6	3	0	1	0	0	3	11	14	10	8	7	12	7
1934	0	1	1	0	0	1	0	0	1	3	0	6	2	3	1	0
1933 & 34	**14**	7	7	3	0	2	0	0	4	14	14	**16**	10	10	13	7

In the case of the Noctuidae it will be seen that while the figures in both cases are small there is no evidence of any significant change. In *A. rubi* the first brood has its maximum flight in period 3 and the second brood in period 4, but in the periods for both years the numbers for the two are close together. In *L. pallens* the maximum is in the sixth period on the total for each brood, but the distribution in the second brood was very different in the two years.

In the case of the Geometrids *C. unidentaria* and *C. ferrugata* there is distinct evidence that in 1933 the first brood in each species had a maximum in period 1, much earlier than in the second brood. This earliness is not, however, supported by the distribution of the much smaller captures in 1934, and may have been due to an accidental seasonal effect.

Summary of the Distribution in the Lepidoptera.

Fig. 9 shows the periods of maximum flight of all those species of Lepidoptera discussed above which have definite maxima. The species are

TABLE 17.

Family (s.l.)	Dusk.			Mid-night.				Dawn.
	1.	2.	3.	4.	5.	6.	7.	8.
LITHOSIIDAE						*E. lurideola*		
CHELONIIDAE				*D. lubricipeda*		*D. lutea*	*D. mendica*	
HEPIALIDAE	*H. lupulinus*							
LIPARIDAE					←*E. chrysorrhoea*→			
BOMBYCIDAE	←*P. populi*→	*C. potatoria*			*M. neustria*			
DREPANIDAE				←*C. glaucata*→				
NOCTUIDAE	←*A. xanthographa*→	*P. fasciuncula* *T. popularis* *T. secalis* ♀	←*A. rubi*→ ←*L. impura*→	*A. lychnidis*	←*M. gothica*→ *S. tenebrosa* *A. exclamationis* *L. conigera* *T. matura* ← *L. pallens*→ ←*T. secalis* ♂→			
GEOMETRIDAE	←*O. brumata*→	(*A. aescularia*) (*A. badiata*) ←*O. luteolata*→	*C. fluctuata* ←*C. fulvata*→	(*C. alchemillata*)	← *C. pyraliata*→ (*O. dilutata*)			
PYRALIDAE		←*P. costalis*→	←*L. verticalis*→			←*E. forficalis*→		←*H. lutealis*→
CRAMBIDAE		← *C. tristellus*→		←*C. pertellus*→				
PTEROPHORIDAE		*P. monodactylus* (1) (*P. gonodactylus*)	←*P. pallidactylus*→					*P. monodactylus* (2)
TORTRICIDAE	*A. bergmanniana* ←*E. hamana*→	*A. purpurana*			*T. viridana* ← *A. lacunana* *N. roborana*	→		*P. variegana* *A. lundana* *A. striana*
TINEIDAE		*C. quercana* ←*P. maculipennis*→						

Names in brackets are placed from figures of one year only.

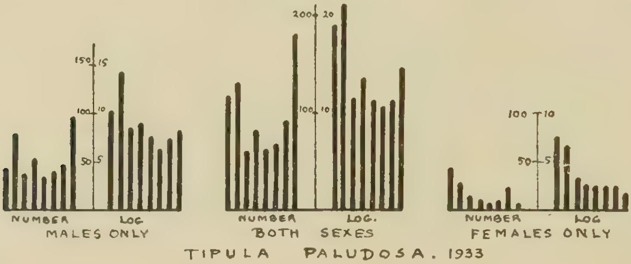
arranged according to family and to the period of the night. Fifty-two species in all are included.

It will be seen that there is considerable variation within a single family or even within a single genus. The TORTRICIDAE are very remarkable in this connection as, of the nine species discussed, three have their maximum in periods 1 and 2, three in period 5 and three in period 8. It is not until many more species have been studied in other localities and over longer periods that the presence or absence of any definite family characteristics can be proved or disproved.

DISTRIBUTION OF SPECIES OF DIPTERA.

Owing to the difficulties of identification very few of the Diptera captured in the trap were identified as to species. The only group in which this was done to any extent was the TIPULIDAE (s.l.). It is hoped that a separate paper on the species, time of occurrence, sexes, and night distribution of this family will be published shortly by another writer.

In the present paper only one species will be referred to, first to show that the same methods are applicable to species of other groups and secondly to illustrate some points already discussed in connection with the Lepidoptera.



9

FIG. 9.—Night distribution of *Tipula paludosa.*

The species in question is *Tipula paludosa* and Table 18 shows the night distribution in the year 1933 on both number and logarithm basis, with the two sexes first separate and then combined. The identifications for the year 1934 are not yet complete.

TABLE 18.

Tipula paludosa.

1933.	1.	2.	3.	4.	5.	6.	7.	8.
NUMBER:								
Males . .	43	80	39	53	34	40	48	**97**
Females . .	**45**	29	13	10	8	10	22	6
Both sexes .	119	131	60	82	62	69	93	**181**
LOGARITHM:								
Males . .	10·2	**14·3**	8·5	9·0	7·5	6·3	7·3	8·3
Females . .	**7·6**	6·7	3·2	2·6	2·5	2·5	2·5	1·7
Both sexes .	19·4	**21·3**	11·6	13·8	11·4	10·7	11·4	14·7

The points worthy of notice are—

(1) The number of males shows a first maximum in period 2 and a higher maximum in period 8. Examination of the detailed figures (not here published) shows, however, that of the 97 males captured in the last period 61 came on the night of the 11th September. In fact this night is another example of a night of outstanding numbers having an abnormal distribution.

(2) This weighting of the last period by one large catch is compensated for by the use of logarithms, and the log. distribution shows only a slight rise in period 8, which is now lower than any of periods 1–4.

(3) The log. distribution shows the males at a maximum in the second period, falling to period 6 and then rising slightly. In the females the maximum is in the first period, and after that there is a continuous but irregular fall to the last period. As in the NOCTUIDAE discussed above the female sex tends to fly earlier than the male.

GENERAL DISCUSSION.

It has been the purpose of this paper to produce evidence as to the distribution during the night of the phototropic activity of certain insects. The species discussed are all those that have come into the trap in sufficient numbers and which have been easy to identify rapidly. No effort has been made to select species to prove any particular case.

For the results to be of value it is necessary first that the insects should show certain individuality in their times of activity, and secondly that the mechanism used for trapping should be sufficiently accurate to measure this individuality.

Whether this has been achieved or not can best be tested by a comparison of the results obtained in the same species in the two years under discussion.

In Tables 10–14 59 species of Lepidoptera are dealt with which came in sufficient numbers to show more or less definite maxima in each of the two years.

Of these—

in 28 species (or 47·5%) the maxima occurred in the same period in each year,
in 20 species (or 33·9%) the maxima differed by only one period,
in 6 species (or 10·2%) the maxima differed by two periods,
in 3 species (or 5·1%) the maxima differed by three periods,
in 2 species (or 3·4%) the maxima differed by four periods.

Of the two species that differed by as much as 4 periods one was *Trachea secalis* which has been shown to have different distributions in the two sexes, and the cause of difference in the total distributions was a difference in the sex proportion in the two years.

Still further support of the accuracy of the results is found in the case of the moth *Pterophorus monodactylus* which shows two flight maxima during the night, both of which are repeated exactly in the two years, although the total numbers are quite small.

Since the majority of species dealt with appear to repeat each year the same distribution, it is probable that most of the variation found from month to month in the distribution of the higher groups is due to variation in the composition of the catch. In fact it is somewhat surprising that distinct individualities do exist still in the higher groups. They must be due to one or both of two possibilities :—(1) that one species is sufficiently numerous to bias the total results, or (2) that there is a general resemblance in distribution between different species of the same family in a higher group.

The information collected with regard to the species of Lepidoptera does not seem to lend much support to the latter suggestion.

Further discussion will only be possible when a similar trap has been used in a new locality, where the species composing the different groups are likely to be different or at least in different relative abundance. It will then be most interesting to see how accurately the same species keep their individuality of habits.

Superimposed on the normal distribution of the species there are changes brought about by the conditions of any particular night. These will be discussed more fully in a later paper, but for the moment we will recall two facts already noted :—First that the distribution on " good " nights tends to be later than that on " poor " nights, and secondly that in several groups and species abnormally good nights, often the nights of the largest catch of the year, tend to have abnormal distribution, usually with a maximum near the end of the night, or at least considerably later than the normal. The second case is apparently merely an exaggeration of both cause and effect in the first.

SUMMARY.

(1) A light-trap is described which has under it eight killing bottles arranged so that by a clockwork mechanism they can be changed at any desired times during the night. Normally they are set so that each one occupies one-eighth of the night, which is considered to last from half an hour after sunset to half an hour before dawn. The period of each bottle varies from 50 minutes at midsummer to just under 2 hours at midwinter. In practice the timing is changed once a week.

(2) By adding together the captures in these periods in successive nights an average distribution of any group or species or sex of one species can be obtained.

(3) In the case of groups or species in which very large numbers are sometimes captured it has been found desirable to sum the logarithms of the numbers rather than use the actual numbers. This prevents single nights with large captures from swamping the results of many nights with smaller numbers.

(4) The trap was working in the fields at Rothamsted Experimental Station, on all except 17 nights in the two years from 1st March 1933 to 28th February 1935, and 109,344 insects were captured in the first year and 103,362 in the second.

(5) The distribution of all insects together showed a maximum at the beginning of the night in the first or second period and a steady fall to about half the numbers in the last. In one year, however, there was a distinct rise from period 7 to 8.

(6) A comparison of the distribution of the good and poor nights considered separately showed that on the poor nights the captures fell rapidly from a maximum in the first period; while on the good nights the captures keep on at a high level, and may not reach their maximum till periods 2 or 3.

(7) The total Diptera (which make up about 76% of the total catch) show a maximum in the first period, but there is considerable variation in the different families. The PSYCHODIDAE have their maximum in period 1 or 2,

the CECIDOMYIDAE in period 3, while the CHIRONOMIDAE have two peaks to the curve, one (the highest) in period 1 and a second lower peak in period 8.

(8) The Lepidoptera (which makes up about 16% of the total captures) are later than the Diptera and reach their maximum in periods 2–4. The NOCTUIDAE are later (4–6) and the GEOMETRIDAE (3–5) a little earlier than the NOCTUIDAE.

(9) Among the other orders (which together only comprise 8% of the total captures) the Coleoptera show a maximum in the first period, and the JASSIDAE two very distinct peaks, the highest in period 1 and a second in period 8.

(10) A number of species of Lepidoptera of various families are discussed and nearly all are shown to have an individuality of distribution. One species has two maxima in periods 2 and 8. The periods of maxima of 52 species are shown on a diagram (Table 17).

(11) There is a tendency in many groups for nights with abnormally high catches to have abnormal distributions, usually later or very much later than the normal.

(12) One species of Noctuid (*Trachea secalis*) is shown to have a strikingly different distribution in the two sexes, and five other moths have less marked differences. In all these cases the female appears earlier than the male. In the very small material available no difference could be demonstrated between the habits of the same species in successive broods.

(13) Of the 59 species of Lepidoptera which gave definite maximum flight periods in both of the two years, 28 had their maxima in the same period each year and 20 only differed by one period in the two years. That is to say that 81% of the species appeared to keep to the same maximum period within the limits of error of the instrument used for measuring this period.

REFERENCES.

BALLOU, H. A., 1920, The Pink Boll Worm in Egypt in 1916–1917. Ministry of Agriculture, Cairo, Egypt.

DELASSUS, M., 1931, *Int. Bull. Plant Prot.*, Rome., **5** (1) : 4–5.

HUSAIN, M. F., KHAN, M. H., and RAM, G., 1934, Studies in *Platyedra gossypiella*, the Pink Boll Worm of cotton in the Punjab. *Ind. J. Agric. Sci.*, **4** : 244.

KABURAKI, T., and KAMITO, A., 1929, Attraction of Rice Borer Moth to Lights at Different Periods. *J. Coll. Agric. Tokyo*, **10** : 151–158.

SEAMENS, H. L., and GRAY, H. E., 1934, Design of a new type of light-trap to operate at controlled intervals. *Rep. Quebec Soc. Plant. Prot.* **25–26** : 39–46.

WILLIAMS, C. B., 1921, Report on the Froghopper Blight of Sugar Cane in Trinidad. *Mem. Dept. Agric. Trinidad*, **1** : 57.

——, 1924, An Improved Light Trap for Insects. *Bull. ent. Res.*, **15** : 57.

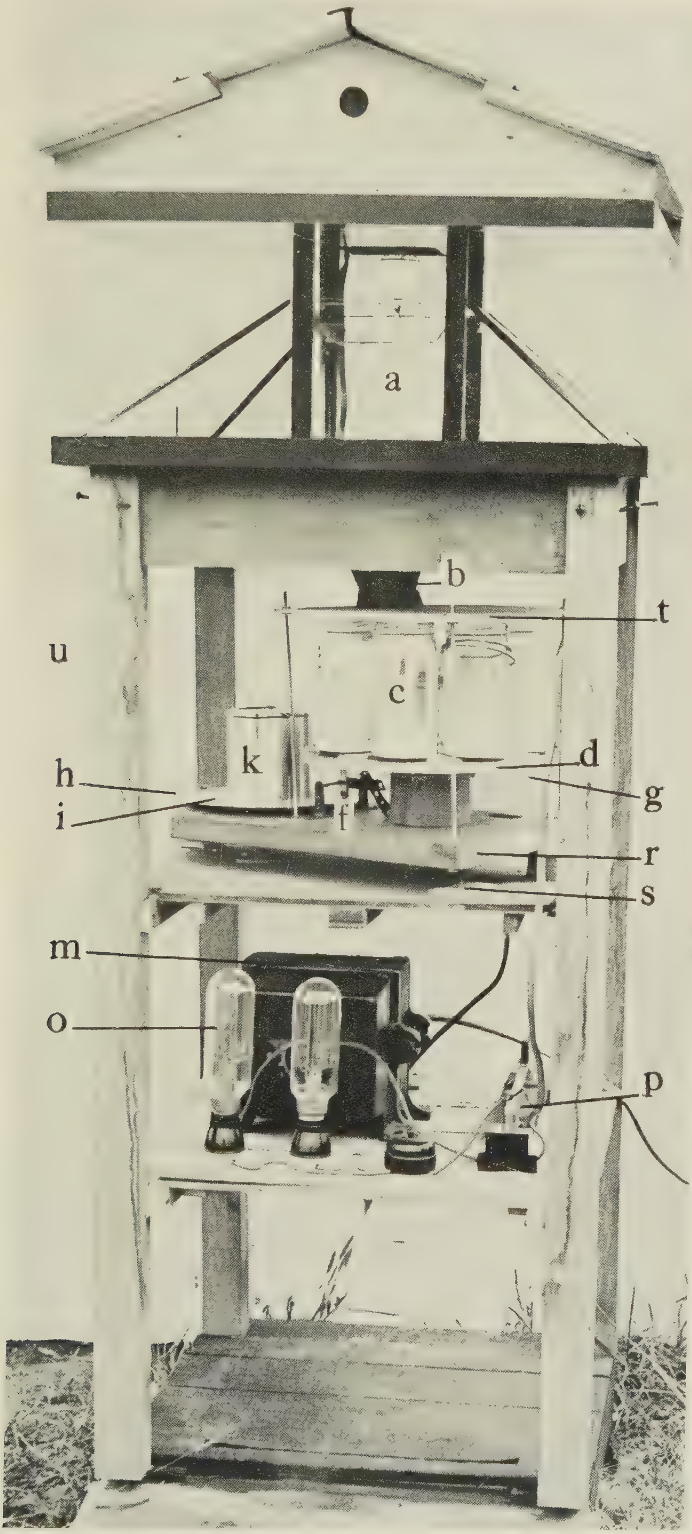
EXPLANATION OF PLATES XV AND XVI.

PLATE XV.

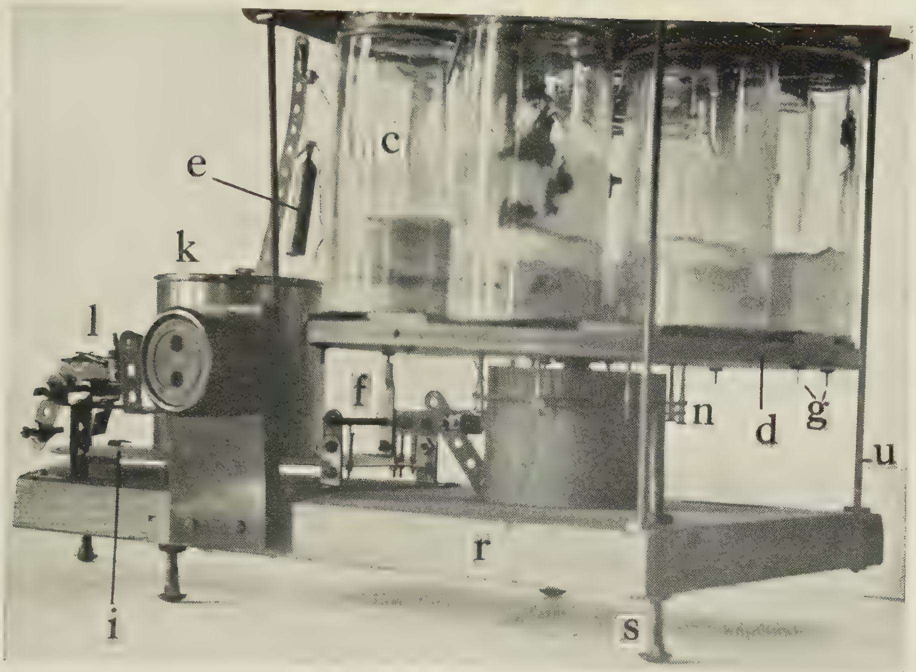
Light-trap for insects with bottle-changing mechanism, and apparatus for stabilising the electric current in order to keep the light constant.

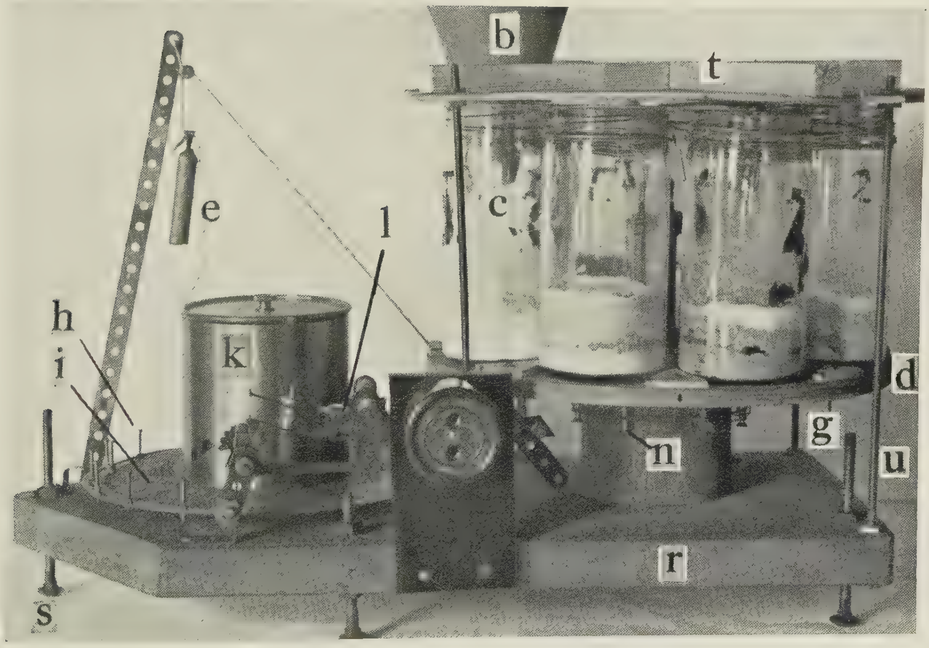
PLATE XVI.

Two views of the mechanism for changing the killing bottles at any specified time during the night.


a
b
t
u
c
k
d
h
g
i
f
r
s
m
o
p

A light-trap for catching insects.


c
e
k
l
f
n
d
g
u
r
i
s


b
t
c
e
l
h
i
k
d
g
n
u
r
s

Mechanism for changing killing bottles in a light-trap for catching insects.

NEW TRICHOPTERA AND PLECOPTERA IN FRANCE: SOME AUVERGNE PLECOPTERA

By Martin E. Mosely.

[Read 1st May, 1935.]

With Eight Text-figures.

In the course of a series of collecting trips in France extending through a period of more than ten years and mainly in search of Trichoptera and Plecoptera, a number of species new to science have been discovered and described. In addition to these, there are three or four which I have not been able to separate from known species as regards genitalia but which nevertheless differ in respect to other characters.

For a long time they have remained unnamed in my collection, but the forthcoming publication of a catalogue of the French Trichoptera makes it desirable that some decision should be taken with regard to their position.

McLachlan did not take any hard and fast line that species should be separated only on characters of the genitalia; witness his *Leptocerus interjectus*, *Mystacides monochroa* and others; it may be that Trichopterists who have followed him have been led to take too rigid a view and attach undue importance to these characters to the exclusion of others.

I describe in this paper the species to which I have referred above as new, though, as regards the Trichoptera, in no instance can I base the descriptions on characters of genitalia. In the *Leuctra* (Plecoptera) new species, the structural differences separating it from *inermis* are so vague that the distinguishing character is mainly the very definite colour markings of the legs in both sexes.

Of the new Trichoptera, I first saw *Drusus nigrorectus* in 1924 when, in company with Mr. K. J. Morton, I visited the Auvergne. At Le Lioran we each took females of the species plentifully, but males were rather scarce. On my return, I determined the species with some hesitation as *Drusus* (*Stasiasmus*) *rectus* McL., a Pyrenean insect, but remarked that not only was the insect smaller and darker in colour than the Pyrenean form, but that the pouch in the posterior wing of the male was lacking the pencil of yellowish hairs which is a feature of this species.

Mr. Morton suggested that as females were more plentiful than males, the insects had been long on the wing and that consequently the pouch had been denuded. This view was not supported by the examination of very large numbers of other *Drusus* species where the pencil of hairs was invariably present, though sometimes a little difficult to make out. However, as at Mount Dore both sexes were present in countless numbers and still emerging during my visit this view is evidently without foundation.

I might here mention that the late Dr. Ris informed me that the pouch is sometimes empty in *Drusus trifidus*. The pencil, however, is often very obscure in this species, but I had no difficulty in finding it in the examples he indicated when I soaked the wing in KOH and softened its tissues.

Another species, *Glossosoma pyrenaica* sp. n., is based on the substitution of simple hairs for androconia scales on the callosity found at the base of the anterior wing. I noticed this species first in 1923 at Mont-Louis in the Pyrenees, but failed to separate it on structures of genitalia from *G. vernale.* Since then I have taken it in other parts of the Pyrenees and also in the Auvergne and Isère.

The third Trichopteron, *Leptocerus fulvoguttatus* sp. n., was first taken by me near Mende in Lozère in 1924, subsequently at Remiremont in the Vosges and finally in 1935 in Corrèze at Bort-les-Orgues. I can see no differences in genitalia to separate the species from *Leptocerus bilineatus*, but the striking snowy-white markings of the anterior wings of the latter species are replaced by a fulvous spot, very conspicuous when the wings are closed so that the insect can be easily mistaken for *L. aterrimus* in its general appearance; the white markings are entirely wanting.

I give here a list of the Plecoptera taken at Bort-les-Orgues, Corrèze and Mont-Dore, Puy-de-Dôme; the Trichoptera will appear in the forthcoming French catalogue.

The new Plecopteron is a *Leuctra* belonging to the *inermis* group. This also was first taken by me at Mont-Louis, but although at the time I considered it a distinct species, the material available was not sufficiently abundant, nor in good enough condition, for any definite conclusions to be drawn. At Mont-Dore, Puy-de-Dôme, I took the insect in great numbers and found also a few examples in my collection from Le Lioran, and I now describe it under the name *L. flavomaculata* sp. n.

Mention might be made of the curious little *Isopteryx* with abbreviated wings, described by Mr. D. E. Kimmins under the name *I. manevali*, and also two examples of *Nemoura nimborella*, described by myself originally from Swiss material and new to the French fauna. A very useful capture was made of several males of *Leuctra despaxi*, of which only a single male in poor condition has hitherto been known.

I am indebted to Monsieur R. Despax of the University of Toulouse, for the determination of the *Taeniopteryx* and *Rhabdiopteryx* spp. and also *Perla abdominalis* from Bort-les-Orgues.

Trichoptera.

LIMNOPHILIDAE.

Drusus nigrorectus sp. n. (figs. 1–3).

Head, thorax dark fuscous clothed with tawny brown hairs; antennae and palpi dark fuscous; wings dark smoky, anterior, clothed with short tawny pubescence, posterior with a pouch but *without* a pencil of hairs; neuration very distinct. Abdomen black with pleurites and distal margins of the segments light reddish-brown. Legs light fuscous spurs generally 0.2.3 ♂ and 1.2.3. ♀, but with occasional variations.

Genitalia, ♂, not distinguishable from that of *D.* (*Stasiasmus*) *rectus* McL.

Genitalia, ♀; above the tubular piece are two broad triangular processes, darker in colour than the adjacent tissues; they are very broad at the bases both from above and from the side; from the latter aspect may be seen a small triangular side piece with a rounded apex; from beneath there is a very large vulvar scale, outer lobes large, apices rounded, inner lobe small, shorter than the outer; from the side, the outer lobes appear as triangular processes broad at the base and as long as the tubular piece.

Length of anterior wing, ♂ and ♀, very variable, from 8 to 13 mm.

FRANCE: Cantal, Le Lioran, 9–19.vii.1924; Puy-de-Dôme, Mont-Dore, 26.vi–8.viii.1934.

Type ♂ from Le Lioran, a microscope preparation in the Author's collection.

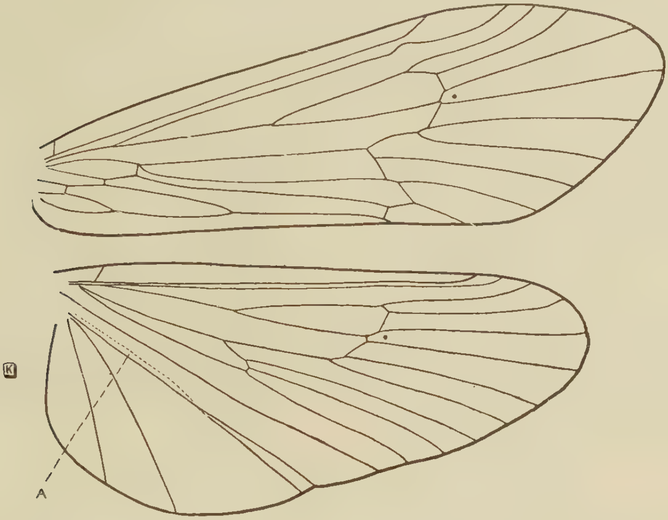
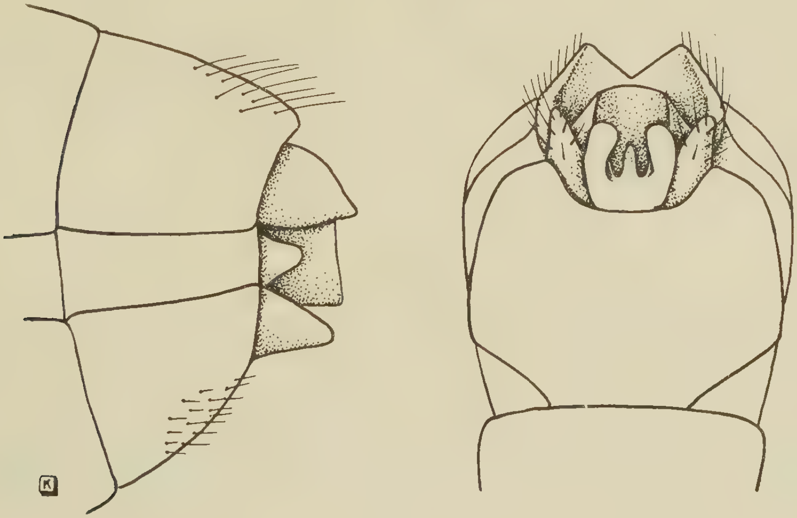


FIG. 1.—*Drusus nigrorectus* sp. n. ♂. Wings, A, empty pouch of the posterior wing.



FIGS. 2–3.—*Drusus nigrorectus* sp. n. ♀. 2, genitalia lateral; 3, ventral.

Paratypes ♂ and ♀ in great numbers from both localities in the Author's, the British Museum and the Paris Museum collections.

LEPTOCERIDAE.

Leptocerus fulvoguttatus sp. n.

Head black, frons clothed with fulvous intermingled with cream hairs; palpi dark fuscous; antennae black with white annulations, legs clothed with adpressed greyish hairs, lighter at the bases of the tarsal joints; anterior wing with a fulvous spot, almost ochraceous, at the arculus so that there is a very conspicuous mark when the wings are closed causing a close resemblance in general appearance to the normal form of *L. aterrimus*; there is a much smaller and fainter spot opposite on the costa, no white markings; posterior wings dark fuscous, clothed with uniformly coloured dark hairs.

Genitalia, ♂. I can find no distinguishing characters from those of *L. bilineatus.*

Length of anterior wing, ♂, 11 mm.
" " " ♀, 9·5 mm.

FRANCE: Corrèze, Bort-les-Orgues, 15–23.vi.1934; Lozère, Mende, 3–8.vii. 1924; Vosges, Remiremont, 5.vii.1930.

Type ♂ (Bort-les-Orgues) in the British Museum collection. Paratypes ♂ and ♀ in the Author's, the British Museum and the Paris Museum collections.

RHYACOPHILIDAE.

Glossosoma pyrenaica sp. n.

G. pyrenaica differs from *G. vernale* solely in the clothing of the callosity at the base of the anterior wing. In *vernale* the callosity is densely clothed with androconia, whilst in *pyrenaica* the androconia are replaced by what appear to be simple hairs.

FRANCE: Aude; Quillan, 18–22.vi.1923; Pyrénées-Orientales; Mont-Louis, 22.vi–2.vii.1923; Olette, 24.vi.1923; Ariège; Ax-les-Thermes, 2–4.vii.1923; Foix, 4–6.vii.1923; Isère; Bourg d'Oisans, 7–14.vii.1925; Corrèze; Bort-les-Orgues, 15–23.vi.1934; Puy-de-Dôme; Mont-Dore, 24.vi–6.viii.1934.

Type ♂ (Mont-Louis) in the Author's collection. Paratypes ♂ and ♀ in the Author's and the British Museum collections.

Plecoptera.

Leuctra flavomaculata sp. n. (figs. 4–8).

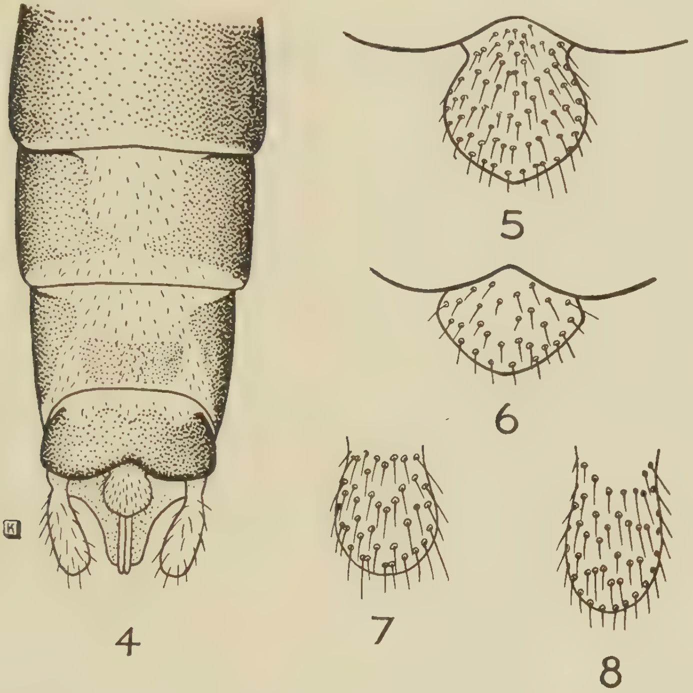
L. flavomaculata is slightly smaller than *L. inermis* and most easily distinguished from it by the colour of the legs. In the anterior pair, the extreme bases of the femora are pale yellow, the remainder fuscous, the tibiae yellow with just a trace of fuscous towards the apices, terminal joints of the tarsi fuscous, remainder yellow; in the median and posterior legs there is a trace of yellow at the apices of the femora, elsewhere the coloration resembles that of the anterior pair. In *inermis*, all the legs are uniformly dark brown, nearly black. In the antennae of *flavomaculata*, the two or three joints beyond the dilated basal joints are yellow, remainder fuscous.

Genitalia, ♂. No outstanding dorsal processes; pigmented borders rather indefinite; those of the 8th segment tend to approximate each other at the distal end, those of the 9th forming shallow triangular plates with rounded apical angles; dorsal marking of the 9th segment somewhat rectangular; supra-anal process short and wide with a very small foot-stalk; in *inermis*, there is rarely, if ever, a foot-stalk; ventral process shorter and rounder than that of *inermis*.

Genitalia, ♀. Lobes of the subgenital plate somewhat similar to those of *inermis*, but perhaps the apices are less rounded, area at their bases not or only slightly swollen.

Length of anterior wing, ♂, 4 mm.
,, ,, ,, ♀, 7 mm.

France: Pyrénées-Orientales, Mont-Louis, 22.vi–2.vii.1923; Aude; Quillan, 18–22.vi.1923; Cantal, Le Lioran, 9–19.vii.1924; Puy-de-Dôme, Mont-Dore, 26.vi–8.viii.1934.



Figs. 4–8.—*Leuctra flavomaculata* sp. n. ♂. 4, abdomen dorsal; 5, supra-anal process, *L. flavomaculata*; 6, supra-anal process, *L. inermis*; 7, ventral lobe, *L. flavomaculata*; 8 ventral lobe, *L. inermis*.

Type is the ♂ of a pair taken coupled at Mont-Dore, mounted in balsam in the British Museum collection. Paratypes ♂ and ♀ in the Author's and British Museum collections.

Auvergne Plecoptera.

Localities in which collections were made during the dates indicated.

France: Corrèze, Bort-les-Orgues, 15–23.vi.1934; Puy-de-Dôme, Mont-Dore, 26.vi–8.viii.1934.

Perla cephalotes Curt., Mont-Dore.
P. marginata Panz., Mont-Dore, Bort-les-Orgues.
P. abdominalis Burm., Bort-les-Orgues.
Taeniopteryx seticornis Klap., Mont-Dore.
Rhabdiopteryx neglecta Alb., Mont-Dore.
Nemoura risi Despax, Mont-Dore.
N. variegata Oliv., Mont-Dore, Bort-les-Orgues.

N. inconspicua Pict., Mont-Dore.
N. occidentalis Despax, Mont-Dore, Bort-les-Orgues.
N. intricata Ris, Mont-Dore, Bort-les-Orgues.
N. nimborum Ris, Mont-Dore.
N. nimborella Mosely, Mont-Dore.
N. cinerea Oliv., Mont-Dore, Bort-les-Orgues.
Chloroperla sp., Mont-Dore, Bort-les-Orgues.
Isopteryx burmeisteri Pict., Mont-Dore.
I. torrentium Pict., Mont-Dore.
I. manevali Kimmins, Mont-Dore.
Leuctra flavomaculata sp. n., Mont-Dore.
L. prima Kempny, Mont-Dore.
L. despaxi Mosely, Mont-Dore.
L. cincta Morton, Mont-Dore.
L. pseudocylindrica Despax, Mont-Dore.
L. inermis Kempny, Mont-Dore.
L. nigra Oliv., Mont-Dore.

GENERAL INDEX

A

abnormis, Amauronematus.
Abraxas grossulariata, gynandromorph of, **509, 514.**
abruptaria, Hemerophila.
Abyssinia, Rhopalocera of, **313–447** (index to spp., **441–447**).
Acanthocrabro vagabundus, **167.**
Acantholyda pinivora, **23.**
acmenus, Lissotes (see *L. helmsi*).
Aculeate Hymenoptera, Nomenclature of, **143–176.**
acuminata, Coelioxys (see *C. inermis*).
acutangulus, Dendroblax ; Figulus.
adelphus, Aegus.
Aegotypus, **115.**
Aegotypus lobicollis, **115.**
Aegotypus marginatus **sp.n.**, from Borneo, **115.**
Aegotypus trilobatus, **115.**
Aegus, **113.**
Aegus adelphus, **114.**
Aegus capitatus (see *A. paralellus*).
Aegus chelifer, **114.**
Aegus frater **sp.n.**, from Gilolo, **114, 115.**
Aegus gestroi, **114.**
Aegus hindenburgi, **113.**
Aegus hopei (see *A. parryi*).
Aegus interruptus, **114.**
Aegus labilis, **114.**
Aegus malabaricus (see *A. paralellus*).
Aegus paralellus, **114.**
Aegus parryi, **114.**
Aegus platyodon, **114.**
Aegus pygmaeus (see *A. adelphus*).
Aegus swalei (see *A. hindenburgi*).
Aegus tutuilensis, **113.**
Aegus upoluensis, **113.**
Aegus (*Xenostomus*) *punctipennis*, **115.**
aeneus, Dolerus.
aenus, Philonthus.
Africa, revision of TELENOMINAE from, **73–103**; Rhopalocera from Abyssinia, **313–447** (index to spp., **441–447**).
Aglae coerulea, parasite of *Euglossa nigrita*, **134.**
Aglia tau, gynandromorph of, **510, 519.**
Aholcus monticola, **73.**
albilabris, Sphecodes.
albotricinctus, Ancistrocerus.
albulata, Asthena.
Alcimus (see *Aegus*).
Alenia **gen.n., 409.**
aleus, Telenomus.
alorus, Anteon.
aloysii-sabaudiae, Microphanurus.
alsius, Amauronematus.
alutaceus, Chelogynus.
Amauris psyttalea, **8.**
Amauronematus abnormis, recorded from Britain, **30.**
Amauronematus alsius **sp.n.**, from Britain, **32.**
Amauronematus mcluckiei **sp.n.**, from Britain, **31.**
amazonica, Polistes canadensis.
America, South, nesting association of birds with insects in, **11–22.**
americana, Periplaneta.
Ammophila lutaria (see *Podalonia affinis*).
Amorpha populi, gynandromorph of, **514, 519, 520.**
ampelophila, Drosophila.
Ancistrocerus albotricinctus, **162.**
Ancistrocerus oviventris (see *A. pictus*).
Ancistrocerus parietum, **162.**
Ancistrocerus pictus, **162.**
Ancistrocerus trimarginatus, **162.**
Ancistrocerus trimarginatus Auctt. (see *A. albotricinctus*).
andamanus, Nigidius (see *N. distinctus*).
Andrena armata, **171.**
Andrena barbilabris, **171.**
Andrena cineraria, **171.**
Andrena cingulata, **171.**
Andrena fulva (see *A. armata*).
Andrena helvola, **171.**
Andrena lapponica, **174.**
Andrena nitida (see *A. pubescens*).
Andrena plumipes (see *Dasypoda hirtipes*).
Andrena pubescens, **171.**
Andrena sericea (see *A. barbilabris*).
Angerona prunaria, gynandromorph of, **511.**
annulata, Prosopis (see *Hylaeus borealis*).
annulatilis, Salius spectabilis.
Anoplocnemus (see *Calcodes*).
Anteon alorus, **151.**
Anteon barbatum, redescription of, **148.**
Anteon crenulatum (see *Dryinus sisythrus*).
Anteon cursor, redescription of, **149.**
Anteon ellimani (see *Chelogynus infectus*).
Anteon fuscoclavatum (see *A. alorus*).
Anteon indivisum (see *A. lyde*).
Anteon jurineanum (see *Dryinus*).
Anteon lyde, synonymy of, **151.**
Anteon maculipenne, **151.**
Anteon melanocera, genotype of *Prenanteon*, **153.**
Anteon nanum, redescription of, **151.**
Anteon obscuricorne (see *A. lyde*).
Anteon parvulum, **152.**
Anteon penidas, **151.**
Anteon rectum (see *A. lyde*).
Anteon rufulocolle, redescription of, **150.**
Anteon scoticum (see *Dryinus sisythrus*).

Anteon vicinum (see *Dryinus sisythrus*).
Anteon vulgare (see *A. penidas*).
Anteon xanthostigma, **152.**
Anthidium, **144.**
Anthidium manicatum, **175.**
Anthophora, *Megilla* a synonym of, **172.**
Anthophora quadrimaculata, **172.**
Anthophora retusa, **172.**
Anthophora tricolor, **138.**
Anthophora vulpina (see *A. quadrimaculata*).
Apatura ilia, gynandromorph of, **512.**
Apis bicornis (see *Osmia rufa*).
Apis conica (see *Coelioxys quadridentata*).
Apis glutinans, **169.**
Apis mellifera, **60, 141, 176.**
Apis mellifica (see *A. mellifera*).
Apoica pallida, nesting association of, **13.**
Aporus bicolor (see *A. unicolor*).
Aporus unicolor, **161.**
Aptinothrips, revision of, **483–508.**
Aptinothrips elegans, **496–497, 502.**
Aptinothrips karnyi, **498, 502.**
Aptinothrips melanophthalmus, **498, 502.**
Aptinothrips rufus, **486, 496, 503–507**; redescription of, **489–492.**
Aptinothrips stylifer, **498, 502, 507.**
Araschnia levana, gynandromorph of, **518.**
aratus, Figulus.
arenaria, Cerceris.
argentata, Dasypoda.
argillacea, Eumenes.
Argynnis paphia, gynandromorph of, **515, 519, 520.**
armata, Andrena ; *Melecta* (see *M. punctata*).
arvensis, Mellinus.
asperlatus, Pristiphora.
Asthena albulata, **46.**
Asthena euthecta (see *Minoa*).
aterrima, Stelis (see *S. punctulatissima*).
atomaria, Ematurga.
atra, Myrmosa.
atratum, Trypoxylon (see *Psenulus*).
atratus, Bombus ; *Psenulus.*
atys, Telenomus.
auge, Nirupama.
Augochlora spp., **133**; habits of, in W. Indies, **136–137.**
aurata, Sphex (see *Omalus*).
auratus, Omalus.
aurita, Endrosa.
auritus, Figulus (see *F. samoanus*).
Azteca chartifex, nesting association of birds with, **11.**

B

barbatum, Anteon.
barbilabris, Andrena.
basalis, Microphanurus.
Bematistes **nom.n.** for *Planema*, **374–376.**
Bembix, **53.**
Bembix rostrata, **144, 169.**
benefactor, Telenomus.
beniensis, Megachile.
bennigseni, Hadronigidius (see *Nigidius divergens*).
Bethylus, British spp., of, **157.**
Bethylus cephalotes, **157.**
Bethylus depressus (see *Pristocera*).
Bethylus formicarius, probably not a valid sp., **157.**
Bethylus fulvicornis (see *B. fuscicornis*).
Bethylus fuscicornis, **157.**
Bethylus hyalinus, **157.**
Bethylus mandibularis (see *B. fuscicornis*).
Bethylus syngenesiae (see *C. fuscicornis*).
betularis, Biston.
bicolor, Aporus (see *A. unicolor*) ; *Dicondylus* ; *Euglossa.*
bicornis, Apis (see *Osmia rufa*).
bifasciatus, Symmorphus.
bifida, Nomada (see *N. ruficornis* L.).
bilineata, Caphys.
biplagiatus, Prosopocoelus.
Birds, nesting associations of, with insects, **11–22.**
Biston betularia, gynandromorph of, **511, 519.**
Blepharipus confusus, **167.**
Blepharipus dimidiatus, **167.**
Blepharipus signatus (see *B. confusus*).
blomeri, Discoloxia.
bobi, Dorcus (see *D. cylindricus*).
Bombus, **140.**
Bombus donovanella, **176.**
Bombus hortorum, **176.**
Bombus hypnorum, **176.**
Bombus lapidarius, **176.**
Bombus lucorum, **176.**
Bombus muscorum, **176.**
Bombus pratorum, **176.**
Bombus sylvarum, **176.**
Bombus terrestris, **176.**
Bombyx mori, gynandromorph of, **510, 514, 519, 520.**
Bombyx quercus, **51.**
borealis, Hylaeus.
borneensis, Aegus.
brachycerus, Dryinus (see *Anteon lyde*).
Bremus truncorum (see *Bombus lapidarius*).
brevicornis, Chelogynus ; *Passaloecus.*
brimo, Telenomus.
British Isles, High mountain sawflies in, **23–29**; early stages of *Minoa murinata* in, **41–46**; nomenclature of Aculeate Hymenoptera from, **143–176**; times of activity of nocturnal insects in, **523–555.**
Brotogerys virescens, nesting association of, with termites, **16.**
bubalus, Nigidius.
burmeisteri, Gnaphaloryx.

C

Cacicus spp., nesting association of, with insects, **11–22.**
Caenolarra (see *Leptolarra*).
caesar, Lucilia.
Calandra granaria, parasite of *Rhizopertha dominica*, **479.**
Calandra oryzae, parasite of *Rhizopertha dominica*, **479.**
Calcodes, **107.**
Calcodes aeratus, **108.**
Calcodes carinatus, **108.**
cambrica, Venusia.
campanularum, Heriades.
campestris, Gorytes (see *G. fargeii*).
canadensis, Polistes.

cancroides, Lissotes.
caniola, Lithosia.
Caphys bilineata, in termite nest, **17.**
capitatus, Aegus (see *A. paralellus*).
cardamines, Euchloë.
Cardanus, **121.**
Cardanus sulcatus, **121.**
Cardanus variolosus **sp.n.**, from Siam, **121.**
carinata, Cephalonomia (see *C. tarsalis*).
carinatus, Lygaeonematus.
Cemonus rugifer, **165.**
Cemonus unicolor (see *C. rugifer*).
centaureae, Hesperia (see *Pyrgus*).
Centris, **138–139.**
centuncularis, Megachile.
Cephalonomia forciformis, **156.**
Cephalonomia tarsalis, **156.**
Cephalonomia waterstoni, **156, 479.**
cephalotes, Bethylus.
Ceratina cyanea, **174.**
Ceratina cyaniventris, **138.**
Cerceris arenaria, **169.**
Cerceris cunicularia, **169.**
Cerceris emarginata (see *C. sabulosa*).
Cerceris fasciata, **169.**
Cerceris labiata (see *C. cunicularia*).
Cerceris quadricincta (see *C. fasciata*).
Cerceris sabulosa, **169.**
Ceryle aenea, nesting association of, with termites, **16.**
Chaetospila elegans, parasite of *Rhizopertha dominica*, **479.**
chartifex, Azteca.
chelifer, Aegus.
Chelogynus alutaceus **sp.n.**, from Britain, **152.**
Chelogynus brevicornis, doubtfully recorded from Britain, **153.**
Chelogynus fulviventris, **152.**
Chelogynus fusiformis (see *C. infectus*).
Chelogynus gracilicollis (see *C. fulviventris*).
Chelogynus infectus, **152.**
Chelogynus walkeri (see *Prenanteon luteipes*).
Cheyletus eruditus, enemy of *Rhizopertha dominica*, **478.**
Chlorion, **144.**
Chloroperla sp., from France, **265.**
Chrysis cyanea, **158.**
Chrysis fulgida, **159.**
Chrysis ignita, **159.**
Chrysis iris, **159.**
Chrysis pallidicornis, genotype of *Spintharis*, **158.**
chrysostomus, Clytochrysus.
cineraria, Andrena.
cinereus, Gnaphaloryx (see *Dorcus velutinus*).
cingalensis Odontolabis (see *Calcodes carinatus*).
cingulata, Andrena.
Cis pygmaeus, **157.**
Cladognathus (see *Dorcus*).
clavicornis Apis (see *Sapyga*).
cleopatra Gonepteryx.
Cleptes pallipes, **157.**
Cleptes semiauratus, **157.**
clibrichellus, Pachynematus.
Clostera curtula, gynandromorph of, **511.**
clypeata, Clypeocrabro.
Clypeocrabro, **nom.n.**, **167.**
Clypeocrabro clypeata, **167.**
Clytochrysus, genotype fixed, **167.**
Clytochrysus chrysostomus, fixed as genotype, **168.**
Clytochrysus zonatus, **168.**
coactulus, Lygaeonematus.
coarctata, Corynopus ; Vespa (see *Eumenes*).
cochinchinensis, Figulus.
codrus, Telenomus.
Coelioxys acuminata (see *C. inermis*).
Coelioxys inermis, **175.**
Coelioxys quadridentata, **175.**
Coelioxys rufipes, habits of, **137.**
Coelocrabro, genotype fixed, **166.**
Coelocrabro leucostomoides **nom.n.**, **166.**
Coelocrabro leucostomus (L.)=*Crabro carbonarius* Dahlb., **166.**
Coelocrabro pubescens, fixed as genotype, **166.**
Coereba luteola, nesting association of, with insects, **14.**
coerulea, Aglae.
coerulescens, Osmia.
Colias croceus, gynandromorph of, **510, 515, 517.**
Colias spp., gynandromorphs of, **515, 518.**
Colletes cunicularia, **170.**
Colletes picistigma (see *C. similis*).
Colletes similis, **170.**
Colletes succincta, **169.**
confusus, Blepharipus.
conica, Apis (see *Coelioxys quadridentata*).
continuus, Crabro (see *Solenius*).
continuus, Solenius.
Conurus spp., nesting association of, with termites, **16.**
coomani, Figulus.
copricephalus, Penichrolucanus.
cordata, Euglossa.
Corynopus coarctata, **168.**
Corynopus nigrinum, **168.**
Crabro cribrarius, **166.**
Crabro continuus (see *Solenius*).
Crabro kiesenwetteri (see *Corynopus nigrinum*).
crabro, Vespa.
crassicornis, Psammochares.
crassimanus, Prenanteon.
Cratolarra (see *Larra*).
cribrarius, Crabro.
croceus, Colias.
Crossocerus palmipes Auctt. (see *C. tarsatus*).
Crossocerus palmipes (L.), **167.**
Crossocerus tarsatus, **167.**
Crossocerus varius (see *C. varus*).
Crossocerus varus, **167.**
Cryptocheilus (see *Salius*).
cubana, Augochlora.
cubensis, Nomada.
cunicularia, Cerceris ; Colletes.
curson, Dryinus (see *Anteon*).
cursor, Anteon.
curtula, Clostera.
curvicornis, Lissotes.
cyanea, Ceratina ; Sphex (see *Chrysis*).
cyaniventris, Ceratina.
Cybosia mesomella, **8.**
cylindricus, Dorcus.
Cynips, **53.**
cynthia, Philosomia.

D

danaus, Microphanurus.
Danaus plexippus, **62.**

daos, Dryinus.
Dasypoda argentata, **172.**
Dasypoda hirtipes, **172.**
Dasypoda thomsoni, **172.**
davidis, Gnaphaloryx (see *Dorcus*).
Dendroblax acutangulus **sp.n.**, from New Zealand, **122.**
Dendroblax earlei, **122.**
depressa, Pristocera.
depressus, Bethylus (see *Pristocera*).
derasa, Centris.
Deuteragenia variegata, **160.**
Diaphora sordida, gynandromorph of, **514.**
Dicondylus, **145, 147.**
Dicondylus bicolor, **147.**
Dicondylus striatus, **147.**
Dicycla oo, gynandromorph of, **513.**
dilatata, Eubussea (see *Aegus*).
dilatatus, Alcimus (see *Aegus*).
dilaticollis, Aegus.
dimidiatus, Blepharipus ; Euglossa.
Dinetes, **53.**
Dineurus (see *Cemonus*).
Dioclea guianensis, pollination of, by insects, **142.**
Discoloxia blomeri, **46.**
dispar, Lymantria.
distinctus, Nigidius.
distinguendus, Lariophagus.
divergens, Nigidius.
divisus, Sphecodes (see *S. ephippius*).
Dolerus aeneus, from high mountains in Britain, **25.**
Dolerus haematodes, **23.**
Dolichoderus sp., nesting associations of, **13.**
dominica, Rhizopertha.
donovanella, Bombus.
Dorcus, **109** ; *Gnaphaloryx davidis* transferred to, **113.**
Dorcus bobi (see *D. cylindricus*).
Dorcus cylindricus, **109.**
Dorcus flavidus, **109.**
Dorcus henryi **sp.n.**, from Ceylon, **110.**
Dorcus histrio **sp.n.**, from India, **109.**
Dorcus humilis **sp.n.**, from India, **111.**
Dorcus mohnikei, **109.**
Dorcus nageli **sp.n.**, from Assam, **112.**
Dorcus obscurus (see *D. platymelus*).
Dorcus opacipennis (see *D. suturalis*).
Dorcus oweni, **110.**
Dorcus pascoei, **110.**
Dorcus platymelus, **107.**
Dorcus rosti (see *D. cylindricus*).
Dorcus rudis, **105.**
Dorcus suturalis, **109.**
Dorcus velutinus, **109.**
Drosophila ampelophila, **55.**
Drusus nigrorectus **sp.n.**, from France, **558.**
DRYINIDAE, types of, **144–145.**
Dryinus, **144.**
Dryinus ephippiger (see *Chelogynus fulviventris*).
Dryinus brachycerus (see *Anteon lyde*).
Dryinus cursor (see *Anteon*).
Dryinus daos, *Prenanteon integer* a synonym of, **155.**
Dryinus frontalis, **154.**
Dryinus fulviventris (see *Chelogynus*).
Dryinus inclytus (see *Chelogynus infectus*).
Dryinus infectus (see *Chelogynus*).
Dryinus jurineanus, **152.**
Dryinus longicornis, **153.**
Dryinus lyde (see *Anteon*).
Dryinus otiartes, redescription of, **148.**
Dryinus penidas (see *Anteon*).
Dryinus rapax, **153.**
Dryinus sisythrus, **147.**
dubius, Evagetes.
Dufourea, genotype fixed, **172.**
Dufourea minuta, fixed as genotype, **172.**
dvalin, Hemisodorcus (see *Prosopocoelus wimberleyi*).

E

earlei, Dendroblax.
elaphus, Lucanus.
electo, Colias.
elegans, Aptinothrips ; Augochlora ; Chaetospila ; Symmorphus.
ellimani, Anteon (see *Chelogynus infectus*).
elongatus, Penichrolucanus.
emarginata, Cerceris (see *C. sabulosa*).
Ematurga atomaria, gynandromorph of, **513.**
emortualis, Protopolybia.
enceladus, Microphanurus.
Endrosa aurita, gynandromorph of, **514.**
Epeolus productus (see *E. variegatus*).
Epeolus variegatus, **173.**
ephippiger, Dryinus (see *Chelogynus fulviventris*).
ephippius, Sphecodes.
Episyron rufipes, **161.**
equestre, Trypoxylon (see *Mimesa*).
equestris Auctt., *Mimesa* (see *M. rufa*).
equestris Fabr., *Mimesa.*
erate, Colias.
Erebia pronoe, gynandromorph of, **514.**
ericsoni, Aegus.
eruditas, Cheyletus.
Eubussea (see *Aegus*).
Eucera longicornis, **172.**
Euchloë cardamines, gynandromorph of, **509.**
Euchoeca nebulata, **46.**
Eudia pavonia, gynandromorph of, **519.**
Euglossa bicolor, **140.**
Euglossa cordata, **139.**
Euglossa dimidiata, **140.**
Euglossa fasciata, habits of, in W. Indies, **140.**
Euglossa nigrita, nest and parasites of, **134–136.**
Eumenes argillacea, not a British sp., **162.**
Eumenes coarctata, **161.**
Eupsittula nana, nesting association of, with termites, **16.**
europaea, Tachytes.
eurytheme, Colias.
Eurytrachelus (see *Dorcus*).
euthecta, Minoa.
Evagetes dubius, **161.**
exaltatus, Priocnemis.
Exomalopsis pulchella, **139.**

F

Fabricius, "Systema Piezatorum," date of publication of, **144.**
Falcicornis (see *Dorcus*).
fargeii, Gorytes.
fasciata, Cerceris ; Euglossa.
femoralis, Leptinopterus.

femorata, *Cratolarra* (see *Larra maura*); *Tiphia*.
ferruginata, *Nomada*.
ferruginatus, *Sphecodes*.
Figulus, **118–119**.
Figulus acutangulus **sp.n.**, from Tonkin, **120**.
Figulus aratus **sp.n.**, from India, **119**.
Figulus auritus (see *F. samoanus*).
Figulus cochinchinensis, **121**.
Figulus coomani **sp.n.**, from Tonkin, **120**.
Figulus napu, **121**.
Figulus samoanus, **119**.
Figulus yunnanensis, **121**.
filicornis, *Tachysphex*.
flammeolaria, *Hydrelia*.
flavicornis, *Prenanteon*.
flavidus, *Dorcus*.
flavomaculata, *Leuctra*.
florisomnis, *Heriades*.
Fluvicola pica, nesting association of, with insects, **14**.
Formica rufa, **54**.
formicarius, *Bethylus*.
formiciformis, *Cephalonomia*.
forsiusi, *Pteronidea*.
fossorius, *Metacrabro*.
France, new Trichoptera and Plecoptera from, **557–562**.
frater, *Aegus*.
freija, *Pyrgus*.
frontalis, *Dryinus*; *Gonatopus*.
fulgida, *Chrysis*.
fulva, *Andrena* (see *A. armata*).
fulvicornis, *Bethylus* (see *B. fuscicornis*).
fulvipes, *Melipona*.
fulviventris, *Chelogynus*; *Osmia* (see *O. ventralis*); *Planiceps*.
fulvoguttatus, *Leptocerus*.
Furnarius, nesting association of, with insects, **15**.
furva, *Nomada*.
fuscicornis, *Bethylus*.
fuscipennis, *Sphecodes* (see *S. albilabris*).
fuscoclavatum, *Anteon* (see *A. alorus*).
fuscus, *Psammochares*.
fusiformis, *Chelogynus* (see *C. infectus*).

G

Gallenia rubescens, **133**.
gazella, *Odontolabis*.
germanica, *Nomada* (see *N. ferruginata*).
gestroi, *Aegus*.
gibbus, *Psammochares* (see *P. trivialis*); *Sphecodes*.
glabella, *Nomada*.
glaucus, *Papilio*.
Glossosoma pyrenaica **sp.n.**, from France, **560**.
glutinans, *Apis*.
glutinosus, *Hylaeus*.
Gnaphaloryx, **113**.
Gnaphaloryx burmeisteri, **113**.
Gnaphaloryx cinereus (see *Dorcus velutinus*).
Gnaphaloryx davidis (see *Dorcus*).
Gnaphaloryx opacus, **113**.
Gnaphaloryx taurus (see *G. burmeisteri*).
Gonatopus flavicornis, not a synonym of *Prenanteon crassimanus*, **154**.
Gonatopus frontalis, **154**.
Gonatopus ljunghii, redescription of, **146**.
Gonatopus oratorius, redescription of type of, **145**.
Gonatopus sepsoides, redescription of, **146**.
Gonatopus sociabilis, **147**.
Gonepteryx cleopatra, gynandromorph of, **509**.
Gonepteryx rhamni, gynandromorph of, **509**.
Gorytes campestris (see *G. fargeii*).
Gorytes fargeii, **168**.
Gorytes mystaceus, **168**.
gowdeyi, *Telenomus*.
gracilicollis, *Chelogynus* (see *C. fulviventris*).
gracilis, *Lucanus*; *Passaloecus*.
granaria, *Calandra*.
griseola, *Lithosia*.
grossulariata, *Abraxas*.
Gynandromorphs, origin of, in Lepidoptera, **509–513**.

H

Hadronigidius bennigseni (see *Nigidius divergens*).
haematodes, *Dolerus*.
Halictus, genotype fixed, **170**.
Halictus poeyi, habits of, **136**.
Halictus quadricinctus, fixed as genotype, **170**.
Halictus tumulorum, **170**.
halidayi, *Prenanteon*.
Hedychrum intermedium, **158**.
Hedychrum rutilans (see *H. intermedium*).
Heliconius, **7**.
helmsi, *Lissotes*.
helvola, *Andrena*.
Hemerophila abruptaria, gynandromorph of, **510, 511, 519**.
Hemisodorcus (see *Dorcus*).
Hemisodorcus dvalin (see *Prosopocoelus wimberleyi*).
henryi, *Dorcus*.
herbaceae, *Pontania*.
Heriades campanularum, **176**.
Heriades florisomnis, **176**.
Heriades truncorum, **176**.
Hesperia centaureae (see *Pyrgus*).
Hesperia freija (see *Pyrgus*).
hindenburgi, *Malietoa* (see *Aegus*).
hirta, *Osmia* (see *O. leiana*).
hirtipes, *Dasypoda*.
histrio, *Dorcus*.
hopei, *Aegus* (see *A. parryi*).
Hoplisus, **144**.
Hoplisus quadrifasciatus, **168**.
hortorum, *Bombus*.
humeralis, *Spintharis*.
humilis, *Dorcus*.
hyalinus, *Bethylus*.
Hydrelia flammeolaria, **46**.
Hydrelia testaceata, **46**.
Hylaeus borealis, **170**.
Hylaeus glutinosus, **169**.
hylas, *Platytelenomus*.
hyperborea, *Pristiphora*.
hyperion, *Telenomus*.
hypnorum, *Bombus*.

I

ignita, *Sphex* (see *Chrysis*).
ilia, *Apatura*.

ilus, Dryinus (see *Prenanteon*).
inachus, Kallima.
incarum, Bombus.
inclytus, Dryinus (see *Chelogynus infectus*).
indivisum, Anteon (see *A. lyde*).
inermis, Centris ; Coelioxys.
infectus, Chelogynus.
Insects, nesting associations of birds with, **11–22.**
insignis, Passaloecus.
integer, Prenanteon (see *Dryinus daos*).
intermedium, Hedychrum.
interruptus, Aegus.
iphias, Telenomus.
iris, Chrysis.
Isopteryx spp., from France, **562.**

J

jurineanus, Dryinus.
juruana, Polybia occidentalis.

K

Kallima inachus, gynandromorph of, **518.**
karnyi, Aptinothrips.

L

Labeo vitripennis (see *Laberius*).
Laberius vitripennis, **145.**
labiata, Megilla (see *Macropis*).
labilis, Aegus.
lagopoda, Megachile.
lanieri, Melissodes.
lapidarius, Bombus.
lapponica, Nomada.
Lariophagus distinguendus, parasite of *Rhizopertha dominica*, **479.**
Larra, synonym of, **163.**
Larra maura, **163.**
Larra pompiliformis, **163.**
Larrada (see *Larra*).
Lasiocampa trifolii, gynandromorph of, **512.**
Lasius, **144.**
laticornis, Nigidius.
Latreille, "Hist. nat. Crust. Ins." 1802, date of publication of, **174**; "Hist. nat. Fourmis" 1802, date of publication of, **174.**
latreillei, Planiceps.
leiana, Osmia.
Lepidoptera, origin of gynandromorphs in, **509–513.**
Leptinopterus femoralis, **107.**
Leptocerus fulvoguttatus **sp.n.**, from France, **560.**
Leptolarra, genotype fixed, **164** ; *Notogonia* a synonym of, **164.**
Leptolarra nigricans reticuloides **subsp.n.**, **164.**
Leptolarra reticulata (see *L. nigricans reticuloides*).
lesbia, Colias.
Leucospis, **53.**
leucostomoides, Coelocrabro.
leucostomus (L.), *Coelocrabro.*
leucostomus Auctt., *Coelocrabro* (see *C. leucostomoides*).
Leuctra spp., from France, **562.**
Leuctra flavomaculata **sp.n.**, from France, **560.**
levana, Araschnia.
Light-trap, times of activity of nocturnal insects taken at, **523–555.**
ligniseca, Megachile.
Limenitis populi, gynandromorph of, **509, 512.**
Linnaeus, examination of types of Hymenoptera described by, **143.**
Liris, **164.**
Liris opulenta, **164.**
Lissotes acmenus (see *L. helmsi*).
Lissotes cancroides, **107.**
Lissotes curvicornis, **107.**
Lissotes helmsi, **122.**
Lithosia caniola, **8.**
Lithosia griseola, brush-organs in male of, **7–9.**
Lithosia lurideola, **8.**
ljunghii, Gonatopus.
lobicollis, Aegotypus.
longicornis, Dryinus ; Eucera.
longimana, Centris.
LUCANIDAE, classification of, **105–125.**
Lucanus elaphus, **107.**
Lucanus gracilis, **106.**
Lucanus villosus, **106.**
Lucanus westermanni, **106.**
Lucilia caesar, **54.**
Lucilia sericata, **60.**
lucorum, Bombus.
luctuosa, Melecta.
lurideola, Lithosia.
lutaria, Ammophila (see *Podalonia affinis*).
luteipes, Prenanteon.
lyde, Anteon ; Dryinus (see *Anteon*).
Lygaeonematus spp., from high mountains in Britain, **34.**
Lymantria dispar, gynandromorph of, **519, 520.**
Lymantria monacha, gynandromorph of, **510, 512.**
Lyroda, **165.**
Lyrops (see *Tachytes*).

M

maculipenne, Anteon.
malabaricus, Aegus (see *A. paralellus*).
Malietoa (see *Aegus*).
mandibularis, Bethylus (see *B. fuscicornis*).
manicatum, Anthidium.
marginatus, Aegotypus ; Cladognathus (see *C. occipitalis*).
maro, Microphanurus.
maura, Larra.
mcluckiei, Amauronematus.
Megachile beniensis, habits of, **137.**
Megachile lagopoda, **175.**
Megachile ligniseca, **175.**
Megachile poeyi, habits of, **137.**
Megathymus sp. **142.**
Megilla (see *Anthophora*).
Megilla labiata (see *Macropis*).
melanocarpa, Pristiphora.
melanocera, Anteon.
melanophthalmus, Aptinothrips.
melanocephala, Mutilla (Fabr.) (see *Myrmosa atra*) ; *Mutilla* Schrank (see *Pezomachus*) ; *Pezomachus.*

Melecta armata (see *M. punctata*).
Melecta luctuosa, **173.**
Melecta punctata, **172.**
Melipona fulvipes, **141.**
Melissa rufipes, **138.**
Melissodes lanieri, **139.**
Melissodes mimica, **139.**
Melissodes pullata, **139.**
Melitta, genotype fixed, **172.**
Melitta tricincta, fixed as genotype, **172.**
mellifera, Apis.
mellifica, Apis (see *A. mellifera*).
Mellinus arvensis, **169.**
Mellinus quadrifasciatus (see *Hoplisus*).
menecles, Microphanurus.
mesomella, Cybosia.
Metachrostis perla, gynandromorph of, **514.**
Metacrabro fossorius, **168.**
Metopodontus (see *Dorcus*).
Microphanurus, key to spp., **96–97.**
Microphanurus aloysii-sabaudiae, redescription of, **102.**
Microphanurus basalis, redescription of, **100.**
Microphanurus danaus **sp.n.**, from Africa, **103.**
Microphanurus enceladus **sp.n.**, from Africa, **99.**
Microphanurus maro **sp.n.**, from Africa, **99.**
Microphanurus menecles **sp.n.**, from Africa, **98.**
Microphanurus mopsus **sp.n.**, from Africa, **97.**
Microphanurus orontes **sp.n.**, from Africa, **102.**
Microphanurus seychellensis, redescription of, **97.**
Microphanurus striaticeps, redescription of, **100.**
miles, Aegus.
Mimesa, **144.**
Mimesa equestris Auctt. (see *M. rufa*).
Mimesa equestris Fabr., **166.**
Mimesa rufa, **166.**
mimica, Mellisodes.
Minoa euthecta, **41.**
Minoa murinata, early stages of, **41–46.**
minuta, Dufourea.
minutulus, Psammochares.
minutus, Psammochares (see *P. minutulus*).
misor, Dryinus (see *Prenanteon*).
mniszechi, Pseudolucanus (see *Lucanus westermanni*).
mohnikei, Dorcus.
molitor, Tenebrio.
mollis, Lygaeonematus.
monacha, Lymantria.
monticola, Aholcus.
mopsus, Microphanurus.
mori, Bombyx.
Morphota (see *Lyroda*).
morphus, Nirupama.
murarius, Symmorphus.
murinata, Minoa.
muscorum, Bombus.
Mutillids, from Pacific Islands, **177–312** (index to spp., **308–312**).
myersi, Nasutitermes.
myrmecophila, Rhabdepyris.
myrmidone, Colias.
Myrmosa atra, **159.**
Myrmosa melanocephala (see *M. atra*).
mystaceus, Gorytes.
Mystrophorus subapterus, **149.**

N

nageli, Dorcus.
nanum, Anteon.
napi, Pieris.
napu, Figulus.
Nasutitermes sp., **13.**
Nasutitermes myersi, nesting association of, with birds, **16.**
nebulata, Euchoeca.
Necrophagus, **54.**
neglecta, Rhabdiopteryx.
Nemoura spp., from France, **561.**
Neolucanus (see *Calcodes*).
Neossiosynoeca scatophaga, larvae of, in association with *Psephotus chrysopterygius*, **17.**
nephele, Telenomus.
nicobaricus, Penichrolucanus.
Nigidius, **118, 119.**
Nigidius andamanus (see *N. distinctus*).
Nigidius bubalus, **119.**
Nigidius distinctus, **119.**
Nigidius divergens, **119.**
Nigidius laticornis, **119.**
Nigidius nitidus, **119.**
Nigidius rhodesianus **sp.n.**, from Africa, **119.**
Nigidius validus (see *N. divergens*).
Nigidius welwitschi, **119.**
nigricans, Leptolarra.
nigriceps, Polybia.
nigrinum, Corynopus.
nigripes, Oxybelus.
nigrita, Euglossa.
nigrorectus, Drusus.
Nirupama **gen.n., 93.**
Nirupama auge **sp.n.**, from Africa, **94.**
Nirupama morpheus **sp.n.**, from Africa, **93.**
nitida, Andrena (see *A. pubescens*).
nitidus, Nigidius ; Odontolabis ; Tachysphex.
Nocturnal insects, times of activity of, **523–555.**
Nomada bifida (see *N. ruficornis* L.).
Nomada cubensis, **138.**
Nomada ferruginata, **173.**
Nomada furva, **174.**
Nomada germanica (see *N. ferruginata*).
Nomada glabella, **174.**
Nomada ruficornis Auctt. (see *N. incompleta*).
Nomada ruficornis L., **173.**
Nomada rufocincta, **174.**
Nomada sheppardana (see *N. rufocincta*).
Nomada tibialis, **138.**
Nomadacris septemfasciata, **1.**
Nomia robinsoni, habits of, **137.**
Notogonia (see *Leptolarra*).
Notogonidea (see *Leptolarra*).
nubium, Pteronidea.
numitor, Telenomus.

O

obductus, Pachynematus.
oberthuri, Torygnognathus.
obscuricorne, Anteon (see *A. lyde*).
obscurus, Dorcus (see *D. platymelus*).
occidentalis, Polybia.
occipitalis, Cladognathus.
ocellatus, Smerinthus.
Odontolabis cingalensis (see *Calcodes carinatus*).

Odontolabis gazella, **107**.
Odontolabis nitidus, **107**.
Odontolarra (see *Lyroda*).
Odontomachus sp., **133**.
Odynerus spinipes, **162**.
Olfactory receptors, location of, in insects, **49–72**.
Omalus auratus, **158**.
oo, Dicycla.
opacipennis, Dorcus (see *D. suturalis*).
opacus, Gnaphaloryx.
opulenta, Liris.
oratorius, Gonatopus.
oriplanus, Phanurus.
orontes, Microphanurus.
oryzae, Calandra.
Osmia coerulescens, **175**.
Osmia fulviventris (see *O. ventralis*).
Osmia hirta (see *O. leiana*).
Osmia leiana, **175**.
Osmia rufa, **175**.
Osmia ventralis, **176**.
Ostinops decumanus, not nesting in association with insects, **12**.
otiartes, Dryinus.
oviventris, Ancistrocerus (see *A. pictus*).
oweni, Dorcus.
Oxybelus, **166**.
Oxybelus nigripes, not a British sp., **166**.
Oxybelus uniglumis, **166**.

P

Pachynematus clibrichellus, from high mountains in Britain, **33**.
Pachynematus obductus, from high mountains in Britain, **34**.
Pacific Ocean, Mutillids of islands in, **177–312** (index to spp., **308–312**).
pacificus, Polistes.
palaeno, Colias.
pallida, Apoica.
pallidicornis, Chrysis.
pallipes, Cleptes ; Psenulus (see *P. atratus*).
palmipes Auctt., *Crossocerus* (see *C. tarsatus*).
palmipes L., *Crossocerus*.
Panyptila cayenensis, nesting association of, with insects, **15**.
paphia, Argynnis.
Papilio glaucus, gynandromorph of, **510, 516, 518**.
Papilio polytes, gynandromorph of, **515, 518**.
paralellus, Aegus.
parcepunctatus, Prenanteon pyrenaicus.
parietum, Ancistrocerus.
parryi, Aegus.
parvulum, Anteon.
pascoei, Dorcus.
Passaloecus, British spp. of, **165–166**.
Passaloecus brevicornis (see *P. insignis*).
Passaloecus gracilis, **165**.
Passaloecus insignis, **165**.
Passaloecus tenuis (see *P. gracilis*).
Passaloecus turionum, possibly a synonym of *P. insignis*, **165**.
pavonia, Eudia.
pectinipes, Psammochares (see *P. crassicornis*) ; *Tachysphex* (see *Larra pompiliformis*).
pedestris, Dicondylus (see *D. striatus*) ; *Gonatopus* (see *Platygonatopus*).
pendulus, Stigmus.
Penichrolucanus, **122**.
Penichrolucanus copricephalus, **122**.
Penichrolucanus elongatus **sp.n.**, from Malaya, **123**.
Penichrolucanus nicobaricus **sp.n.**, from Nicobar Is., **123**.
Penichrolucanus sumatrensis **sp.n.**, from Sumatra, **124**.
penidas, Anteon.
perforatus, Aegus.
Periplaneta americana, **59**.
Perla spp., from France, **561**.
perla, Metachrostis.
personata, Centris.
Pezomachus melanocephala, **159**.
Phanurus oriplanus, **73**.
philodice, Colias.
Philonthus aenus, **53**.
Philosomia cynthia, **51**.
Physoscelus (see *Rhopalum*).
pica, Fluvicola.
picistigma, Colletes (see *C. similis*).
pictus, Ancistrocerus.
Pieris napi, gynandromorph of, **512, 515**.
Pieris rapae, **58** ; gynandromorph of, **513**.
pinivora, Acantholyda.
Pitangus spp., nesting association of, with insects, **14**.
Planiceps latreillei, a valid sp., **161**.
Planiceps fulviventris, a valid sp., **161**.
Platyfigulus **gen.n.**, **117**.
Platyfigulus scorpio **sp.n.**, from Ceylon, **117**.
Platygonatopus pedestris, **147**.
platymelus, Dorcus.
platyodon, Aegus.
Platytelenomus hylas **sp.n.**, from Africa, **74**.
Plecoptera, new, from France, **557–562**.
plexippus, Danaus.
plumipes, Andrena (see *Dasypoda hirtipes*).
Podalonia, **165**.
Podalonia affinis, **165**.
poecila, Centris.
poeyi, Halictus ; Megachile.
polaris, Pontania.
Polistes canadensis, nesting association of, with birds, **13, 14**.
Polistes pacificus, nesting associations of, **13**.
Polybia spp., nesting associations of, with birds, **13–15**.
polycrates, Telenomus.
polytes, Papilio.
pompiliformis, Larra.
Pompilus gibbus (see *P. trivialis*).
Pontania herbaceae, from high mountains in Britain, **27**.
Pontania polaris, recorded from Britain, **28**.
Pontania pustulator, from high mountains in Britain, **25**.
Pontania robbinsi **nom.n.** for *P. femoralis*, **26**.
populi, Amorpha ; Limenitis.
praeclara, Augochlora.
pratensis, Prosopis (see *P. signata*).
pratorum, Bombus.
Prenanteon, genotype fixed, **153**.
Prenanteon crassimanus, redescription of, **154**.
Prenanteon halidayi, **153**.
Prenanteon ilus, redescription of type of, **155–156**.
Prenanteon integer (see *Dryinus daos*).

Prenanteon luteipes, *Chelogynus walkeri* a synonym of, **155**.
Prenanteon misor, redescription of type of, **155**.
Prenanteon procericornis, **153**.
Prenanteon pyrenaicus parcepunctatus, **155**.
Priocnemis exaltatus, **159**.
Prismognathus (see *Dorcus*).
Pristiphora asperlatus **sp.n.**, from Britain, **36**.
Pristiphora hyperborea, **38**.
Pristiphora melanocarpa, **38**.
Pristiphora quercus, **38**.
Pristiphora staudingeri, **38**.
Pristocera, **144**.
Pristocera depressa, **157**.
procas, *Telenomus*.
procericornis, *Prenanteon*.
productus, *Epeolus* (see *E. variegatus*).
prolixus, *Rhodnius*.
Promethea, **53**.
pronoe, *Erebia*.
Prosopis, **144**.
Prosopis annulata (see *Hylaeus borealis*).
Prosopis pratensis (see *P. signata*).
Prosopis rollei, assemblage of, **142**.
Prosopis signata, **170**.
Prosopocoelus biplagiatus, **106**.
Prosopocoelus sulcatipennis (see *Dorcus rudis*).
Prosopocoelus wimberleyi, **106**.
Protopolybia emortualis, nesting association of, **13**.
prunaria, *Angerona*.
Psammochares crassicornis, **160**.
Psammochares fuscus, **160**.
Psammochares minutulus, **160**.
Psammochares minutus Dahlbom (see *P. minutulus*).
Psammochares pectinipes (see *P. crassicornis*).
Psammochares trivialis, **160**.
Psenulus, **144**.
Psenulus atratus, **166**.
Psenulus pallipes (see *P. atratus*).
Psenulus rubicola (see *P. atratus*).
Psephotus chrysopterygius, larvae of *Neossiosynoeca scatophaga* in association with, **17**.
Pseudochrysis Trautmann (see *Spintharis*).
Pseudochrysis Semenow, **158**; genotype fixed, **158**.
Pseudochrysis virgo, fixed as genotype, **158**.
Pseudolucanus mniszechi (see *Lucanus westermanni*).
Psittacula viridissima, nesting association of, with termites, **16**.
Psyttalea, *Amauris*.
Pteronidea forsiusi, recorded from Britain, **29**.
Pteronidium nubium **sp.n.**, from Britain, **30**.
Ptychopoda seriata, gynandromorph, **510**, **511**, **519**.
pubescens, *Andrena*; *Coelocrabro*.
pulchella, *Exomalopsis*.
pullata, *Melissodes*.
punctata, *Melecta*.
punctipennis, *Aegus* (*Xenostomus*).
punctulatissima, *Stelis*.
pygmaeus, *Aegus* (see *A. adelphus*); *Cis*.
pylades, *Telenomus*.
pylus, *Telenomus*.
pyramus, *Telenomus*.
pyrenaica, *Glossosoma*.
pyrenaicus, *Prenanteon*.
Pyrgus centaureae, **127**.
Pyrgus freija, structural characteristics of, **127**.

Q

quadricincta, *Cerceris* (see *C. fasciata*).
quadricinctus, *Halictus*.
quadridentata, *Coelioxys*.
quadrifasciatus, *Hoplisus*; *Mellinus* (see *Hoplisus*).
quadrimaculata, *Anthophora*.
quercus, *Bombyx*; *Pristiphora*.

R

rapae, *Pieris*.
rapax, *Dryinus*.
rectum, *Anteon* (see *A. lyde*).
regina, *Augochlora*.
rejecta, *Polybia*.
reticulata, *Leptolarra* (see *L. nigricans reticuloides*).
reticuloides, *Leptolarra nigricans*.
retusa, *Anthophora*.
Rhabdepyris, genotype fixed, **157**.
Rhabdepyris myrmecophila, fixed as genotype, **157**.
Rhabdiopteryx neglecta, **561**.
rhamni, *Gonepteryx*.
Rhizopertha dominica, biology and distribution of, **449–482**; distribution of, **450**; food of, **453**; life-history of, **455**; natural enemies of, **478**.
rhodesianus, *Nigidius*.
Rhodnius, **61**, **64**.
Rhodnius prolixus, immature stages of, **1–5**.
Rhopalocera, of Abyssinia, **313–447** (index to spp., 441–447).
Rhopalum Auctt. (see *Corynopus*).
Rhopalum Stephens, **168**.
Rhopalum rufiventris, **168**.
Rhynchocyclus sp., nesting association of, with insects, **14**.
robbinsi, *Pontania*.
robinsoni, *Nomia*.
robustus, *Bombus*.
rollei, *Prosopis*.
rosti, *Dorcus* (see *D. cylindricus*).
rostrata, *Bembix*.
rubescens, *Galleria*.
rubicola, *Psenulus* (see *P. atratus*).
rudis, *Dorcus*.
rufa, *Formica*; *Mimesa*; *Osmia*; *Vespa*.
ruficornis Auctt., *Nomada* (see *N. incompleta*).
ruficornis L., *Nomada*.
rufipes, *Coelioxys*; *Episyron*; *Melissa*.
rufiventris, *Rhopalum*.
rufocincta, *Nomada*.
rufulocolle, *Anteon*.
rufus, *Aptinothrips*.
rugifer, *Cemonus*.
rutilans, *Hedychrum* (see *H. intermedium*).

S

sabulosa, *Cerceris*.
Salius, **144**; *Cryptocheilus* a synonym of, **159**.

Salius spectabilis annulatilis **nom.n., 160.**
samoanus, Figulus.
Sapyga clavicornis, **159.**
Sawflies, from high mountains in Britain, **23–39.**
scatophaga, Neossiosynoeca.
sciron, Telenomus.
scorpio, Platyfigulus.
Scotocryptus sp., **133.**
sculptipennis, Aegus.
Selandria wüstnei, **23.**
semiaurata, Sphex (see *Cleptes pallipes*).
sepsoides, Gonatopus.
septemfasciata, Nomadacris.
seriata, Ptychopoda.
sericata, Lucilia.
sericea, Andrena (see *A. barbilabris*) ; *Polybia.*
seticornis, Taeniopteryx.
seychellensis, Microphanurus.
sheppardana, Nomada (see *N. rufocincta*).
signatus, Blepharipus (see *B. confusus*) ; *Prosopis.*
Silpha thoracica, **54.**
silvestriana, Trigona.
similis, Colletes ; *Sphecodes* (see *S. ephippius*).
sinuata, Symmorphus (see *S. sinuatissimus*).
sinuatissimus, Symmorphus.
sisythrus, Dryinus.
Smerinthus ocellatus, **514.**
smithiana, Centris.
sociabilis, Gonatopus.
Solenius, **144.**
Solenius continuus, **168.**
Solenius vagus (see *S. continuus*).
solskyi, Stigmus.
sordida, Diaphora.
Spanolarra (see *Leptolarra*).
spectabilis, Salius.
Sphecodes albilabris, **170.**
Sphecodes divisus (see *S. ephippius*).
Sphecodes ephippius, **171.**
Sphecodes ferruginatus, **171.**
Sphecodes fuscipennis (see *S. albilabris*).
Sphecodes gibbus, **170.**
Sphecodes similis (see *S. ephippius*).
Sphex aurata (see *Omalus*).
Sphex clavipes (see *Rhopalum rufiventris*).
Sphex semiaurata (see *Cleptes pallipes*).
Sphex vaga, **169.**
Spermophila olivacea, nesting association of, with insects, **15.**
spinipes, Odynerus.
Spintharis Bischoff (see *Pseudochrysis* Semenow).
Spintharis Klug, genotype fixed, **158** ; *Pseudochrysis* Trautmann a synonym of, **158.**
Spintharis humeralis, fixed as genotype, **158.**
squalidus, Aegus.
staudingeri, Pristiphora.
Stelis aterrima (see *S. punctulatissima*).
Stelis punctulatissima, **175.**
Stigmus pendulus, type of, **165** ; male = *S. solskyi*, **165.**
Stigmus solskyi, **165.**
striaticeps, Microphanurus.
striatus, Dicondylus.
stylifer, Aptinothrips.
subapterus, Mystrophorus.
succincta, Colletes.
sulcatipennis, Prosopocoelus (see *Dorcus rudis*).
sulcatus, Cardanus.
sumatrensis, Penichrolucanus.
surinama, Synoeca.
suturalis, Dorcus.
swalei, Aegus (see *A. hindenburgi*).
sylvarum, Bombus.
Symmorphus, genotype fixed, **162.**
Symmorphus bifasciatus, **163.**
Symmorphus elegans, fixed as genotype, **162.**
Symmorphus murarius, **163.**
Symmorphus sinuata Fabr. (see *S. sinuatissimus*).
Symmorphus sinuatissimus **nom.n., 162.**
syngenesiae, Bethylus (see *B. fuscicornis*).
Synoeca surinama, nesting associations of, **13.**

T

Tachyptera (see *Tachytes*).
Tachysphex filicornis, **164.**
Tachysphex nitidus, **163.**
Tachysphex pectinipes Auctt. (see *Larra pompiliformis*).
Tachysphex unicolor, **163.**
Tachytes, **163.**
Tachytes europaea, **163.**
Tachytes tricolor, **164.**
Taeniopteryx seticornis, from France, **561.**
tarsalis, Cephalonomia.
tarsatus, Crossocerus.
tau, Aglia.
taurus, Gnaphaloryx (see *G. burmeisteri*).
TELENOMINAE, revision of African spp., **73–103** ; key to genera, **74.**
Telenomus, **74** ; key to spp., **75–76.**
Telenomus aleus **sp.n.**, from Africa, **81.**
Telenomus atys **sp.n.**, from Africa, **86.**
Telenomus benefactor, redescription of, **87.**
Telenomus brimo **sp.n.**, from Africa, **78.**
Telenomus codrus **sp.n.**, from Africa, **83.**
Telenomus cybele **sp.n.**, from Africa, **77.**
Telenomus gowdeyi, redescription of, **91.**
Telenomus hyperion **sp.n.**, from Africa, **81.**
Telenomus iphias **sp.n.**, from Africa, **91.**
Telenomus nephele, **sp.n.**, from Africa, **88.**
Telenomus numitor **sp.n.**, from Africa, **79.**
Telenomus procas **sp.n.**, from Africa, **78.**
Telenomus pylades **sp.n.**, from Africa, **89.**
Telenomus polycrates **sp.n.**, from Africa, **79.**
Telenomus pylus **sp.n.**, from Africa, **83.**
Telenomus pyramus **sp.n.**, from Africa, **86.**
Telenomus sciron **sp.n.**, from Africa, **84.**
Telenomus thestor **sp.n.**, from Africa, **79.**
Telenomus thoas **sp.n.**, from Africa, **78.**
Telenomus tityrus **sp.n.**, from Africa, **85.**
Tenebrio molitor, **59.**
tenuis, Passaloecus (see *P. gracilis*).
Termitaradus, **133.**
Termites, nesting association of, with birds, **16.**
terrestris, Bombus.
testaceata, Hydrelia.
Textor cucullatus, nesting association of, with insects, **15.**
thestor, Telenomus.
thoas, Telenomus.
thomsoni, Dasypoda.

thoracica, Silpha.
Thraupis sclateri, nesting association of, with insects, **15.**
Thyreus (see *Clypeocrabro*).
tibialis, Nomada.
Tiphia femorata, **159.**
Tityra cayana, nesting association of, with termites, **16.**
tityrus, Telenomus.
Torygnognathus **gen.n., 116.**
Torygnognathus oberthuri **sp.n.**, from Sumatra, **116.**
Trichoptera, new, from France, **557–562.**
tricincta, Melitta.
tricolor, Anthophora ; Tachytes.
tricuspis, Aegus.
trifasciatus, Odynerus (see *Ancistrocerus trimarginatus*).
trifolii, Lasiocampa ; Zygaena.
Trigona spp., **141.**
Trigona silvestriana, ethological observations on, **131–134.**
trilobatus, Aegotypus.
trimarginatus Auctt., *Ancistrocerus* (see *A. albotricinctus*).
trimarginatus Zett., *Ancistrocerus.*
trivialis, Psammochares.
Trogon melanopterus, nesting association of, with termites, **16.**
truncorum, Bremus (see *Bombus lapidarius*) ; *Heriades.*
Trypoxylon atratum (see *Psenulus*).
Trypoxylon equestre (see *Mimesa*).
tumulorum, Halictus.
turionum, Passaloecus.
tutuilensis, Aegus.

U

unicolor, Aporus ; Cemonus (see *C. rugifer*) ; *Tachysphex.*
uniglumis, Oxybelus.
upoluensis, Aegus.
Uraeginthus angolensis, nesting association of, with insects, **15.**

V

vaga, Sphex.
vagabundus, Acanthocrabro.
vagus, Solenius (see *S. continuus*).
validus, Nigidius (see *N. divergens*).
variegata, Deuteragenia.
variegatus, Epeolus.
variolosus, Cardanus.
varius, Crossocerus (see *C. varus*).
varus, Crossocerus.
velutinus, Dorcus.
ventralis, Osmia.
Venusia cambrica, **46.**
Vespa coarctata (see *Eumenes*).
Vespa crabro, **163.**
Vespa rufa, **163.**
Vespa vulgaris, **163.**
vicinum, Anteon.
villosus, Lucanus.
virgo, Pseudochrysis.
vitripennis, Labeo (see *Laberius*).
vulgare, Anteon (see *A. penidas*).
vulgaris, Vespa.
vulpina, Anthophora (see *A. quadrimaculata*).

W

Walckenaer, "Fauna parisiensis," 1802, date of publication of, **174.**
walkeri, Chelogynus (see *Prenanteon luteipes*).
waterstoni, Cephalonomia.
welwitschi, Nigidius.
West Indies, ethological observations on insects in, **131–142.**
westermanni, Lucanus.
wimberleyi, Prosopocoelus.
wüstnei, Selandria.

X

xanthostigma, Anteon.
Xenostomus (see *Aegus*).
Xylocopa sp., **138, 142.**

Y

yunnanensis, Figulus.

Z

Zenonia **gen.n., 405.**
zonatus, Clytochrysus.
Zygaena trifolii, gynandromorph of, **514.**

ERRATA.

pp. 116 to 125, substitute reissue with text-figures correctly placed.
p. 169, line 29, for "*Cerceris fasciata*" read "*C. quadrifasciata.*"

Printed in Great Britain by
Richard Clay & Sons, Limited,
BUNGAY, SUFFOLK.